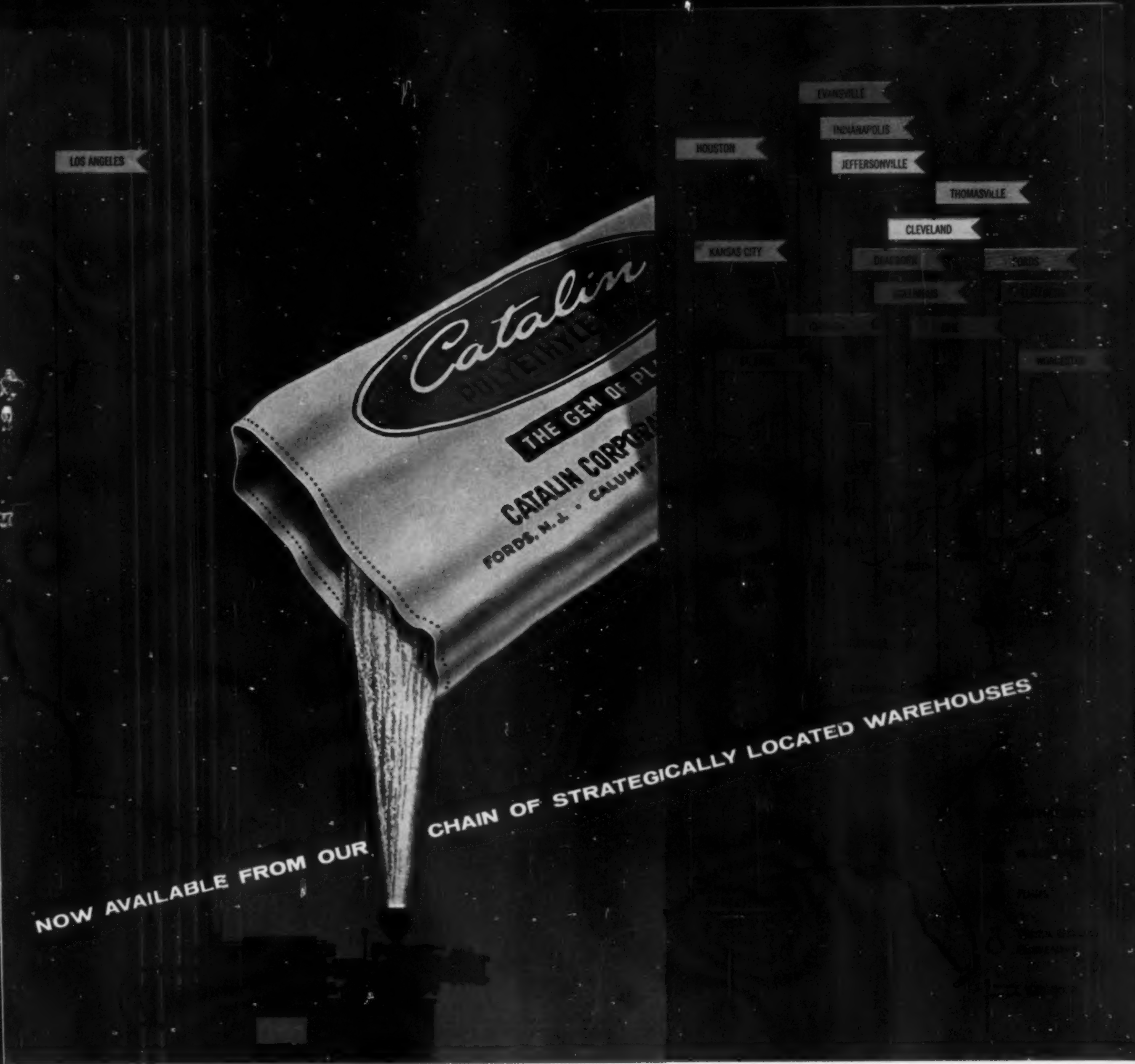
MODERN PLASTICS

MAY 1958

What is the future for plastics in packaging? *page 95*

Know-how on machining TFE fluorocarbon stock *page 123*



Catalin ANNOUNCES

a complete range of both

High Density and Low Density

POLYETHYLENE

molding, blow molding and extrusion compounds

This significant polyethylene announcement makes it possible to receive from a *single quality source* almost every type of high, intermediate and low density polyethylene, *with densities ranging from .915 to .96 and with melt indexes from 0.2 to 50.*

Already supplying a most comprehensive line of polystyrene, acrylonitrile styrene and nylon formulations, Catalin by this new addition makes it possible for the molder, blow molder and extruder with multiple production and end-use specification requirements to order and quickly obtain from one of Catalin's strategically located warehouses the exact type of material he needs, assured of unexcelled quality and service. *Inquiries invited.*

CATALIN CORPORATION OF AMERICA
One Park Avenue, New York 16, N. Y.

MODERN PLASTICS*

Volume 33
May 1956
Number 9

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The Blackman Plastics Company makes this realistic layout for HO train sets from Campco S-540 sheet because Campco is less expensive than many similar kinds of plastic sheet, yet furnishes excellent rigidity and formability. It easily takes painting and flocking to give a realistic appearance.

forms easily, yet sets to play-proof rigidity!

This vacuum-formed model train layout has exceptionally high impact resistance because it's molded from a CAMPCO S-540 rubber-modified styrene sheet. Note the complex, intricate shapes — they're formed easily from this strong, yet lightweight, styrene sheet. CAMPCO's glossy finish permits realistic color detail, too, because it takes to applied colors like boys take to model trains.

CAMPCO is produced by an exclusive process that also results in high dimensional stability and heat resistance, and low moisture absorption. Applications range from 3-D displays and packages, to refrigerator door liners, to toys of all kinds.

Stock CAMPCO styrene sheets, in a wide range of colors, are ready for immediate shipment. Patterns, such as woodgrains and simulated leathers, are also available. CAMPCO stock sheets are mass-produced, thereby effecting a saving to you. CAMPCO also makes styrene sheets in any pattern or color on a custom basis. A special sandwich laminating process bonds the pattern *permanently* to the rubber-modified styrene base protecting it from abrasion.

For data on how CAMPCO styrene sheets can make your product more attractive and more saleable . . . on how they can be formed into an almost endless range of products quickly, and at low cost . . . write or phone:

CAMPCO *sheet and film*

a division of Chicago Molded Products Corp., 2721 Normandy Ave., Chicago 35, Ill.

RUBBER MODIFIED STYRENE • CELLULOSE ACETATE • CELLULOSE BUTYRATE • POLYETHYLENE • COPOLYMER STYRENE

Editorial

Battle with aluminum

As we go to press with this issue a 2¢ drop in aluminum (in pig form) to 24¢ a pound was announced by a major company. This reverses a ten-year trend of price rise from 15¢ a pound in June 1948 to 26¢ a pound in August 1957.

Chief reasons for the cutback, as expressed by aluminum executives, is that the material is now in free supply, that new capacity is scheduled to come into production in many areas, that automotive, residential, and appliance cutbacks have affected use of capacity, and that aluminum must become more competitive with other materials. While one company reports sales at 100% of capacity at present, most are at 80 percent.

The question as to whether further price drops in aluminum are probable brings no comment from the industry except the flat statement by one major producer that its policy is to meet all competition.

And what has all this to do with plastics?

For almost two years the aluminum industry has been vigorously challenging plastics in promotion, in market development, and in publicity.

Item: Refrigerator advertising in national magazines showing anodized aluminum in components which for many years have been made of plastics, and bearing the copy "richer in costly aluminum."

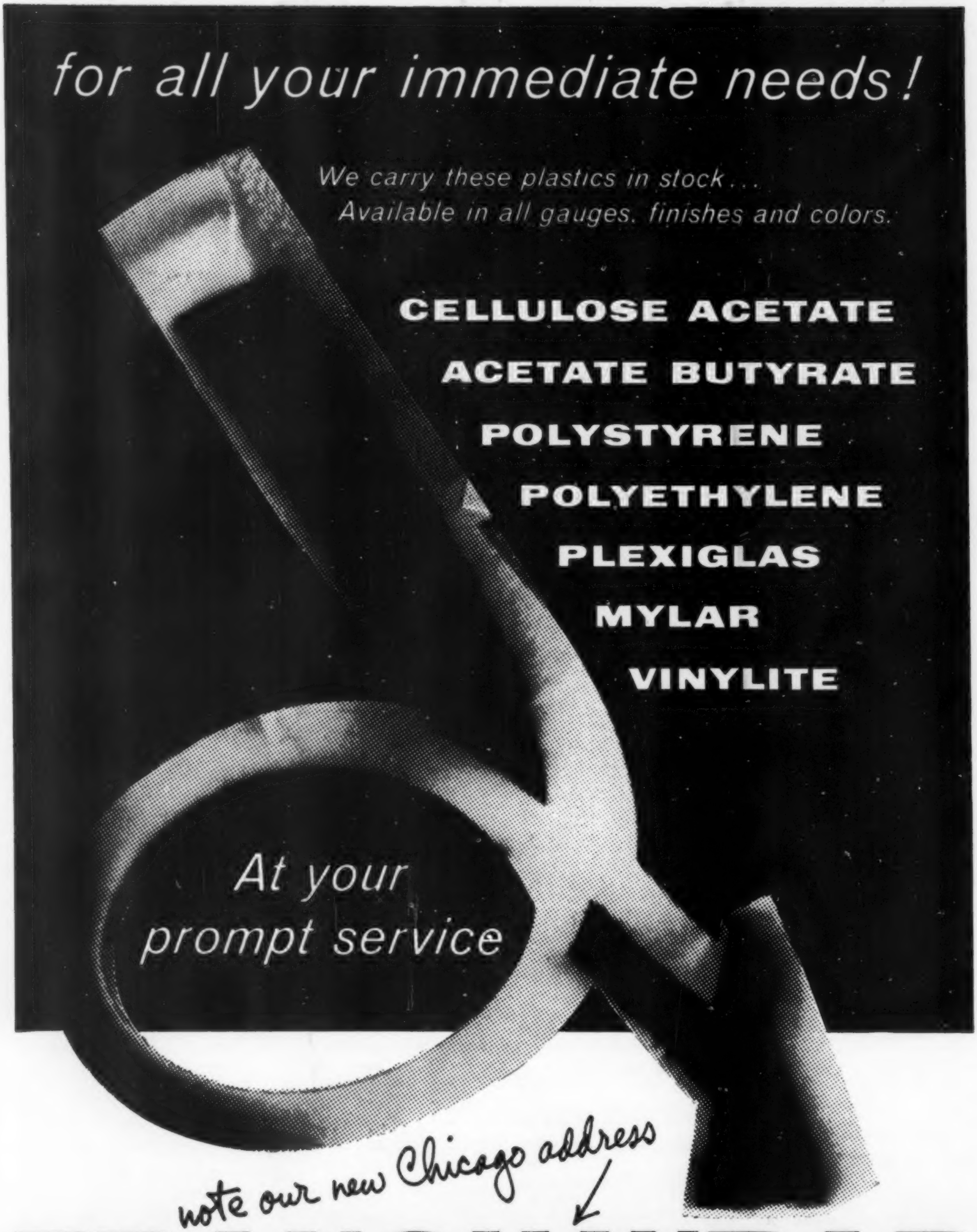
Item: Special request from the marketing department of a major aluminum supplier for copies of our February lead article on plastics boats.

Item: The tremendous interest in vinyl-metal laminates evidenced by not only aluminum fabricators, but aluminum sheet producers (and this goes for the steel industry, too).

Item: Multicolor continuously anodized aluminum in a new line of office furniture.

So it is obvious that price is only one front in the struggle for markets between aluminum and plastics. Aluminum market research teams are studying plastics markets while technical teams are working on combinations of aluminum with plastics only where the metal cannot hope to do the job well.

Any battle presupposes problems in tactics and strategy. We do not have the solutions to those problems. But if all men in plastics know that this battle is going on, they will arrive at the best way to handle the situation.



TRANSILWRAP CO.

4427 North Clark Street • EDgewater 4-8115 • Chicago 40, Illinois

Eastern Division: 1646-49 Henvis Street • DAvenport 9-2241 • Philadelphia 40, Pennsylvania

Southwest Division: 1201 Levee Street • RIverside 1-3415 • Dallas 7, Texas

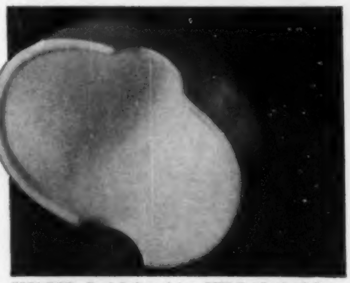
He gets it with this **TOPTEX** police helmet lined with shock-absorbent **DYLITE** expandable polystyrene

RECENTLY, a number of safety helmets, including the Toptex police model, ran a gauntlet of rugged, defect-probing tests. These dramatic tests were set up to study the performance of each helmet under the severest of impact conditions. By far, the most effective protection came from the Toptex helmet . . . primarily because of the non-resilient expanded polystyrene liner. Months of additional testing proved that DYLITE expandable polystyrene offered the best combination of properties for this job.

DYLITE expandable polystyrene liners open the way to use in many fields where safety helmets are necessary—hardhats for industrial or construction crews, telephone company repair crews, miners, the armed forces and others.

DYLITE is strong, yet lightweight—can be molded to controlled densities. Its low K factor makes it an ideal insulating material. Here are other fine plastics from Koppers: DYLENE polystyrene, SUPER DYLAN polyethylene and DYLAN polyethylene. For more information, wire or write Koppers Company, Inc., Plastics Division, Dept. MP-58, Pittsburgh 19, Pennsylvania. *TWX Call number . . . PG 533.*

Dylite, Dylene, Dylan and Super Dylan are registered trademarks of Koppers Company, Inc.



MOLDER: Zant & Associates 5508 N. Vineland Ave. North Hollywood, Calif.

KOPPERS

Offices in Principal Cities
In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario

KOPPERS PLASTICS

TYPICAL PHYSICAL PROPERTIES OF FORTICEL

Flow temperature: (°C.) (A.S.T.M.)	D569-48	167–178
Specific gravity	D176-42T	1.18–1.21
Tensile properties:		
Yield (p.s.i.)	D638-52T	3380–5020
Break (p.s.i.)	D638-52T	3470–5240
Elongation (%)	D638-52T	56–66
Flexural properties:		
Flexural strength (p.s.i. at break)	D790-49T	6400–8500
Flexural modulus (10^6 p.s.i.)	D790-49T	0.23–0.30
Rockwell hardness: (R scale)	D785-51	62–94
Izod impact: (ft. lb./in. notch)	D256-43T	2.7–11.0
Heat distortion: (°C.)	D648-45T	59–70
Water absorption:		
% sol. lost	D570-42	0.00–0.08
% moisture gain	D570-42	1.5–1.8
% water absorption	D570-42	1.6–1.8

WESTCLOX SELECTS FORTICEL

Celanese propionate thermoplastic for its popular "Travalarm"

Trim cargo for the traveler, the Travalarm is a fashion-wise member of the Westclox family of precision-made electric and spring-wound clocks, pocket and popularly priced wrist watches. A handsome traveling companion, the Travalarm comes in either an ivory or black case of lustrous Forticel.

Westclox joins other famous name manufacturers like Zenith, Bissel, American Optical, Ansco, in selecting Forticel because this thermoplastic offers something more in a production material—the toughness and high speed moldability of the cellulosics, and the big plus combination of better dimensional stability, excellent form retention, freedom from unpleasant odor.

Properties like these can give your products an important competitive advantage, too. Write Celanese for complete data. Or, use coupon below.
Celanese Corporation of America, Plastics Division, Newark, N. J.
Canadian Affiliate: Canadian Chemical Co., Limited, Montreal, Toronto, Vancouver.

Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16 — Celanese® Forticel®

Celanese
PLASTICS

Celanese Corporation of America, Plastics Division
Dept. 101-E, 744 Broad Street, Newark 2, N. J.
Please send me New Product Bulletin NP-16 on Forticel Plastic.

NAME____________________

TITLE____________________

COMPANY____________________

ADDRESS____________________

CITY__________ ZONE_____ STATE__________

To impart a slip-proof, safety grip and increase wearability of cotton work gloves, palms and fingers are strategically dotted with **chem-o-sol** specially formulated to permit printing on fabrics at high speeds. *(Wells Lamont Corp.)*

To deaden noise, protect dishes from chipping, and resist grease and detergents, the familiar drainer is dipped in a special **chem-o-sol.** Wire constructions and metal and glass objects are coated easily and economically because only one dipping operation is necessary. Thickness to 60 mils is possible, in wide range of finishes.

To seal the new dry type automotive air cleaner into the car silencer and act as a structural member of the pleated paper element, a **chem-o-sol** was compounded for high-speed molding. Pre-cut gaskets and metal stampings were eliminated. *(Fram Corporation.)*

To improve heat resistance and physical and electrical properties of coatings for flexible sleeving (spaghetti tubing) used in electrical components, a **chem-o-sol** was tailor-made for heat resistance of more than 2000 hours at 225°F.

improve your product

TECHNICAL FACTS ABOUT chem-o-sols

Chem-o-sols possess all the outstanding physical and chemical properties associated with polyvinyl chloride resins. Listed below are some of the properties available in almost any combination.

COLOR CHOICE — unlimited

TENSILE STRENGTH — as required from 1000 psi. to 2700 psi.

PERCENT ELONGATION — 350 to 600

HARDNESS (shore A2) — as required from 10 to 100
(shore D) — up to 65

FLEXIBILITY — to temperatures as low as —65°F

CHEMICAL RESISTANCE — outstanding to most acids, alkalies, detergents, oils and solvents

HEAT RESISTANCE — available to 225°F for as long as 2000 hours and to 450°F for over two hours

DIELECTRIC STRENGTH — minimum of 400 volts per mil when fused in sections 3 mils thick and over

SOLIDS CONTENT — 100%. Chem-o-sols can be molded in very thick sections

VISCOSITY — as required for dipping, die wiping, molding, casting, spraying, or spreader coating

CHEMICAL PRODUCTS CORPORATION
Dept. P5 , King Philip Road
East Providence 14, R. I.

Please send me a free copy of your ***chem-o-sol*** *Brochure.*

Name ....
Title ....
Company ....
Address ....
City .... Zone ...... State ....
Proposed end use ....
....
Application method ....
....

Going Plastisols One Better... **chem·o·sol®**

The Goodyear Tire & Rubber Company Announces A Major Break-Through In Plastics Engineering:

Plastics pioneering is not new to Goodyear.

Stemming from 1935, it has brought forth outstanding films—PLIOFILM for foodstuffs, VITAFILM for glamour packaging of textiles and the like, Vinylfilm for shower curtains, rainwear, industrial tapes and building barriers—each a standout in its field.

But in 1958, Goodyear has achieved a major development in the plastics field.

The product is VIDENE—a polyester film of unique characteristics and physical properties the likes of which have never before been seen.

A Major Milestone

Primarily, VIDENE is a laminating film of revolutionary qualities which will capture the imagination of development engineers, designers and business thinkers.

LIKE OTHER FILMS, it can be used as a protective and decorative surface—

EXCEPT that it resists outdoor aging and weathering like no surfacing and laminating film before it.

EXCEPT that it has from two to eight times the abrasion resistance of films now being used.

EXCEPT that it can be laminated to most materials without requiring an adhesive.

EXCEPT that it can be reverse printed to reproduce virtually any surface or scene that can be color photographed.

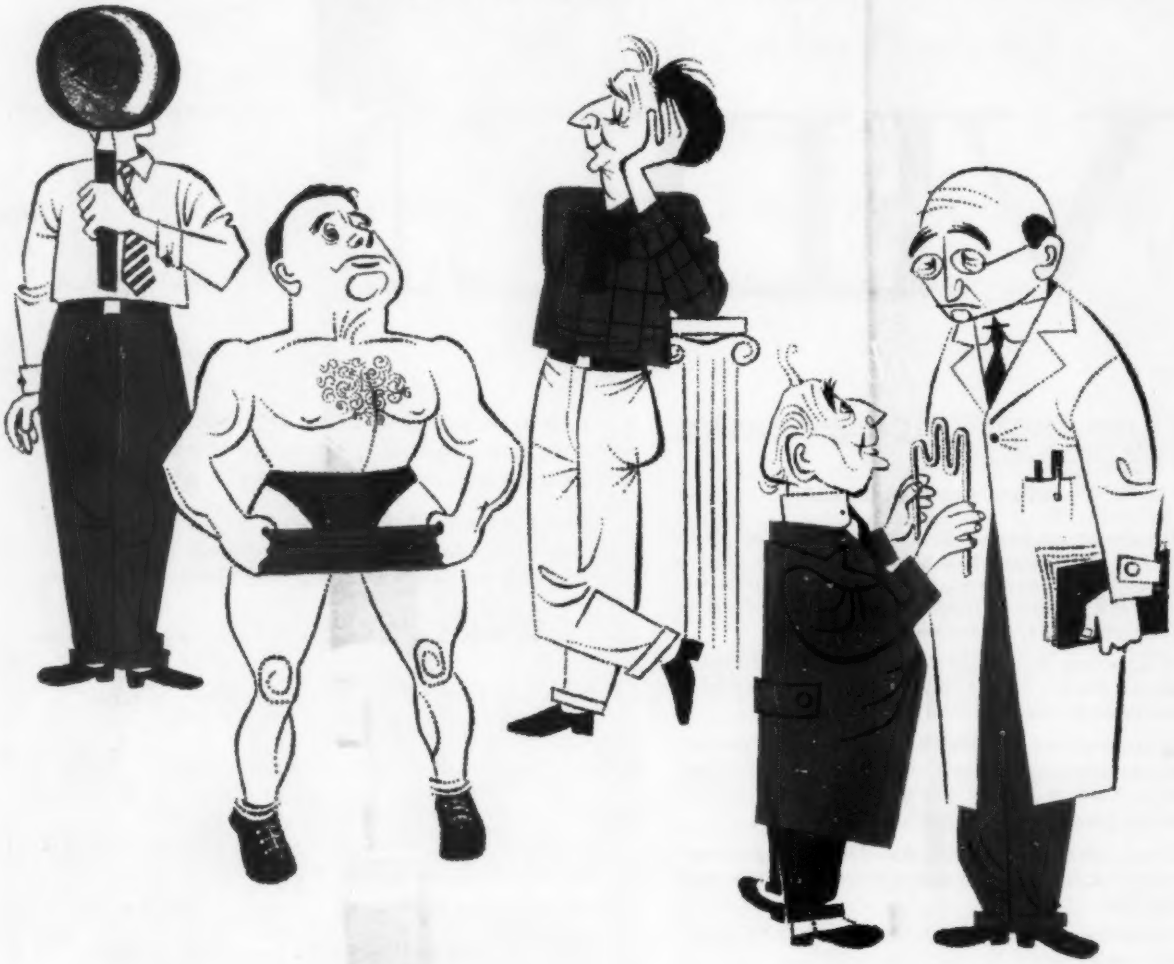
EXCEPT that it can be "gloss controlled"—produced in high gloss and mat finish—embossed to obtain other finishes which are permanent and cannot be rubbed away with wear.

TOPS ANYTHING!

Videne

The Super Film

The Boonton Inspection Staff



Fastidious type. Checks specifications, tolerances, machining qualities.

Athletic type. Tests compressive strength, flexural strength, impact strength, hardness, stiffness.

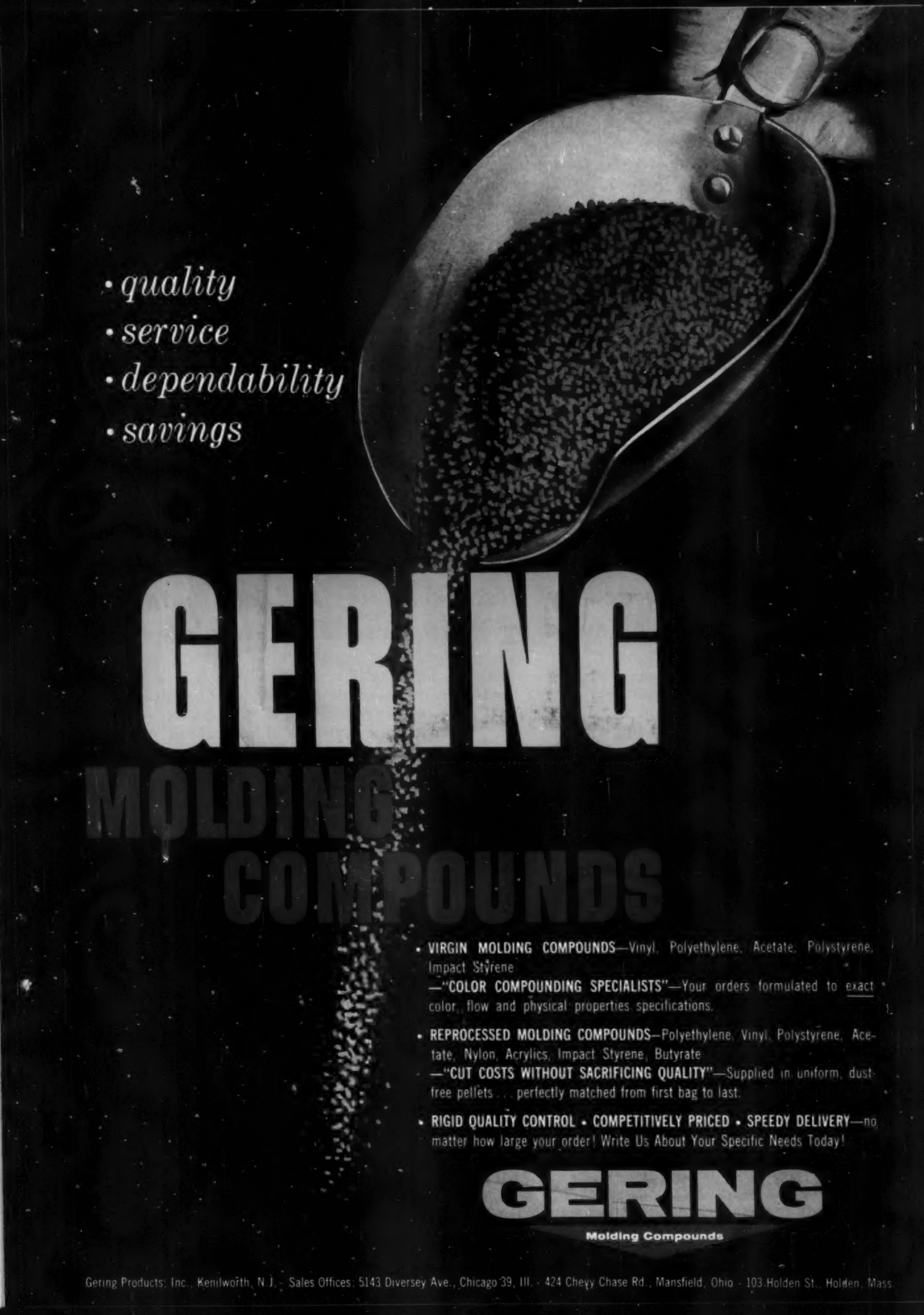
Artistic type. Inspects surface finish, color stability, color uniformity, general appearance.

Scientific types. One tests volume resistivity, dielectric strength, dielectric constant, power factor. The other tests thermal conductivity, heat distortion, thermal expansion.

And they all give *every* compression or injection molding job a thorough going-over.

BOONTON MOLDING CO.
BOONTON, NEW JERSEY

New York Metropolitan Area—Cortlandt 7-0003
Western New York Area—Alden 7134
Connecticut Area—Woodbine 1-2109 (Tuckahoe, N. Y.)
Philadelphia Area—Pioneer 3-0315


• quality
• service
• dependability
• savings
GERING
MOLDING
COMPOUNDS
• VIRGIN MOLDING COMPOUNDS—Vinyl, Polyethylene, Acetate, Polystyrene, Impact Styrene
—"COLOR COMPOUNDING SPECIALISTS"—Your orders formulated to exact color, flow and physical properties specifications.
• REPROCESSED MOLDING COMPOUNDS—Polyethylene, Vinyl, Polystyrene, Acetate, Nylon, Acrylics, Impact Styrene, Butyrate
—"CUT COSTS WITHOUT SACRIFICING QUALITY"—Supplied in uniform, dust-free pellets . . . perfectly matched from first bag to last.
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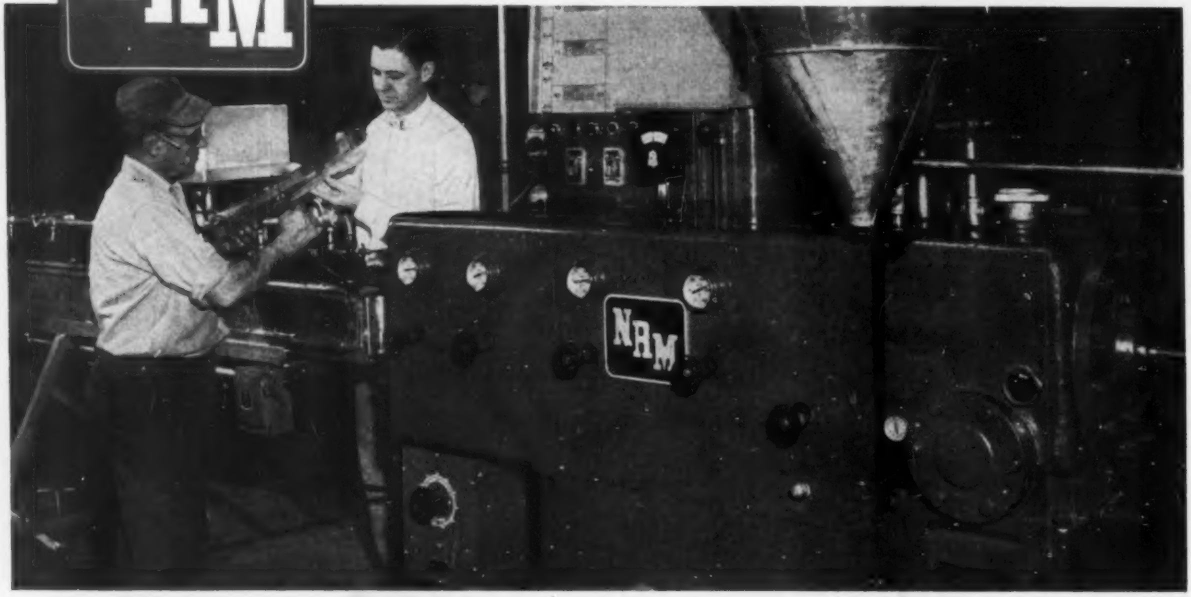
NRM *Thermoplastics* **EXTRUDERS**



—maintain high quality, close tolerances and high output of vinyl extrusions produced by MAYON PLASTICS, Hopkins, Minn.

In 1946 this company began producing flexible, non-toxic vinyl tubing and hose for the food industry, and for use on blood oxygenation equipment for open heart surgery.

Today, *Mayon Plastics* supplies these products for resale throughout the United States and in twenty foreign countries. In commenting on the success of his company, Ray D. Johnson, General Manager, said: "Quality extrusions, competitive prices and ability to deliver quickly are the key factors in our growth, and our NRM's have played a key part in helping us maintain these standards. NRM's are indeed the dependable workhorses of our business."

If *you* are planning to purchase plastics extruders and equipment, look into the NRM Line before you buy. See for yourself how NRM's "years ahead" design and operating advantages increase profit margins and enable plastics producers everywhere to "plan ahead" on company growth.

Just a few important NRM features are "Balanced Heat Control," long cylinder ratios, quick-opening die gates, patented feed screw types, and our latest engineering advancement, *Induction heating* of Extruders. Compare the NRM time saving features, low operating cost and high pounds per hour rates with any other extruder and you'll see why it's important in your profit picture to "go NRM" the next time you buy plastics extruding equipment. Write today.

2942

NATIONAL RUBBER MACHINERY COMPANY NRM

General Offices and Engineering Laboratories: 47 West Exchange St., Akron 8, Ohio
EASTERN PLANT: 384 Getty Ave., Clifton, N. J.
SOUTH: The Robertson Company, Rutland Building, Decatur, Ga.
WEST: S. M. Kipp, Box 441, Pasadena 18, Cal.
MID-WEST: National Rubber Machinery Company, 5875 N. Lincoln Ave., Chicago 45, Ill.
CANADIAN: F. F. Barber Machinery, Ltd., 187 Fleet St., West, Toronto, Ont.
EXPORT: Omni Products Corporation, 460 Fourth Ave., New York, N. Y.

Creative Engineering

Photo courtesy United Plastics & Development Co., Kent, Ohio

New—and worthy of note!

What makes the cone-shaped markers pictured above worthy of note is that they're made of a vinyl plastisol.

The advantages are obvious: Higher strength and lighter weight; greater resistance to water, oils, greases and tars; easier cleaning; translucency for internal lighting; and brighter colors that won't fade, chip, scuff or rub off.

The plastisol used in making these cones is based on a blend of PLIOVIC resins—Goodyear's new PLIOVIC VO, low temperature fusing PLIOVIC AO, and viscosity stabilizing PLIOVIC S50.

The major advantages in using this three-way PLIOVIC blend lie in fast and complete fusion of thick sections at moderate temperature, and balanced flow with a minimum of plasticizer. This eliminates exudation and greatly reduces pigment discoloration. Other advantages include: Ease of mixing. Faithful mold reproduction. Good hot-tear strength. And excellent physical properties. For full details, including the latest *Tech Book Bulletins*, just write:

Goodyear, Chemical Division
Dept. Q-9422, Akron 16, Ohio.

GOODYEAR

CHEMICAL DIVISION

60th ANNIVERSARY

Pliovic—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

HPM PREPLASTICIZER

Extremely Fast . . . Exceptionally High Injection Rate . . . Each Shot Exact In Weight

After being rigorously tested for many months in actual plant operation, these new, fast H-P-M preplasticizing injection machines came up to our every expectation. One machine speeded up large parts production for its owner by over 100% . . . the molding superintendent says "it's the machine of the future." Absolute shot size control is accomplished by the combination operation of a rotary material control valve and an adjustable nut for accurately measuring each shot of material. Let us tell you what these new machines will do for you. Call in a near-by H-P-M engineer or write for complete information today.

A COMPLETELY NEW CONCEPT IN PREPLASTICIZING

These machines are built in three sizes—450-ton—80 oz.; 800-ton—200 oz.; 1500-ton—300 oz. The 80 oz. and 200 oz. machines are illustrated above. They are ideal for filling deep, thin-walled sections or large areas that must be filled rapidly. Parts are better in quality and uniform in size and weight.

Specifications

MACHINE MODEL	450-P-80	800-P-200 SPECIAL	1500-P-300
Material Injected Per Cycle (Oz./max.)	80	200	300
Clamp Tonnage	450	800	1500
Plasticizing Capacity (Lbs. Per Hr.)	200	300	400
Mold Space (Max.)	26½"x36"	36"x55"	48"x72"
Daylight	40"	84"	106"
Mold Thickness (Min. Without Spacer)	15"	30"	46"
Stroke	25"	54"	60"
Rate of Injection (Cu. In./Min.)	1530	5300	6640
Horsepower	75	225	275

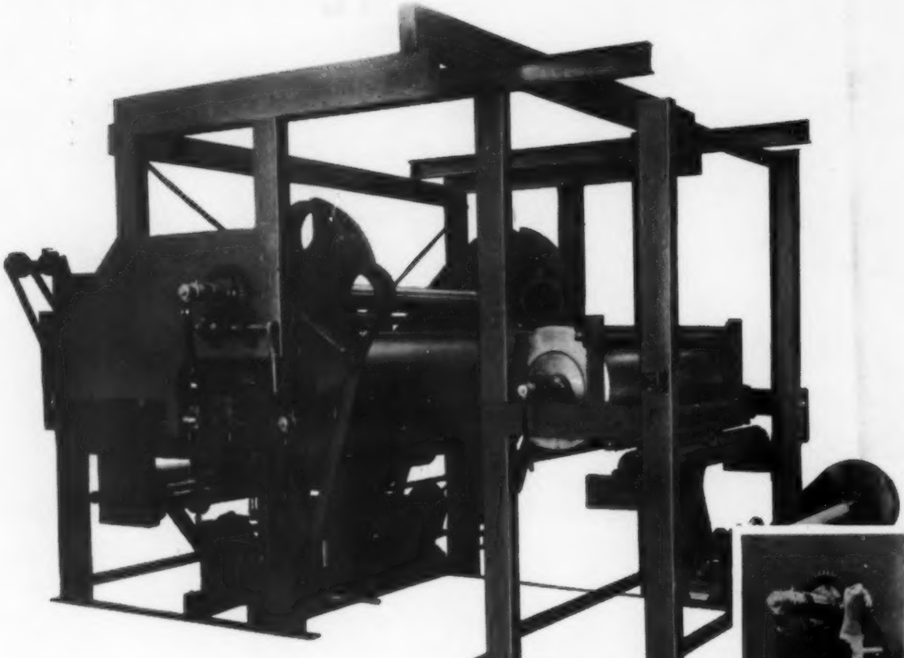
Note: Machines can be equipped for higher speed injection if desired.

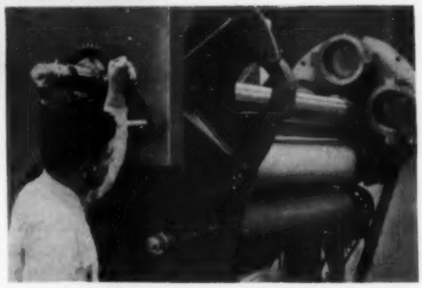
H828

THE HYDRAULIC PRESS MFG. COMPANY HPM

A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U. S. A.

New Lembo
TURRET EMBOSSER





Leave it to Lembo to come up with this handy, practical development on their Embosser. The necessity for frequent shut downs and roll changing in embossing heads is just about eliminated, thanks to the 2-, 3- or 4-roll turret.

Extra! New slat expander, now standard equipment on all Lembo Embossers. Maintains constant width on 60 or 80" face. Also available with new Variable Tension Controller.

Rolls can be changed in a minute or two; either manually or with optional motor drive. Just index to use any of the patterns on whatever plastic film you happen to be running.

Call now! We'll be happy to let you see the new Lembo Turret Embosser in operation.

LEMBO MACHINE WORKS, INC.

ROTOGRAVURE LEMBO PRESS LAMINATION

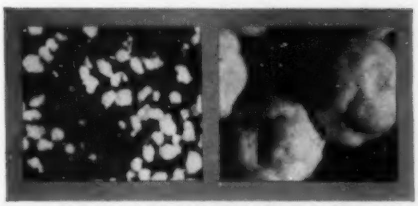
248 East 17th Street • Paterson 4, New Jersey • LAmbert 5-5555
Mfrs. PRESSES • EMBOSSERS • LAMINATORS • ROLLERS

about ESCAMBIA PVC PEARLS*

They – Your competitors—are using Escambia PVC Pearls to improve their profit picture—

Here are a few good reasons why—

- Unusually high plasticizer absorption capacity
- Uniform and free-flowing dry blends
- Outstanding heat stability
- Very low gel count
- Excellent color and clarity
- Fast mill banding characteristics
- Complete freedom from fines
- Uniform particle size



Conventional PVC *Escambia PVC Pearls*
(Each magnified 20 times)

**PVC Pearls is a trademark of Escambia Chemical Corporation. Manufactured in four molecular weights for all general purpose and many specific applications. For samples and additional information on this completely new PVC write or call—*

ESCAMBIA CHEMICAL CORPORATION

261 MADISON AVENUE • NEW YORK 16, N. Y.

for year-around action--

ADVERTISE IN MODERN PLASTICS ENCYCLOPEDIA ISSUE

WHAT IT IS

The Modern Plastics Encyclopedia issue is published annually in September as the thirteenth isssue of Modern Plastics magazine . . . and goes to all Modern Plastics subscribers. It's the accepted "workbook" of the plastics field . bound in handsome hard covers . . . carries the advertising of all the field's leading suppliers answers practically all questions relating to plastics: materials and their properties, their applications, production methods, processing equipment and machinery . contains the only complete Buyers' Directory in the field . . . is completely revised each year to cover all new developments and changes.

Because of its "workbook" nature it's used by plastics men *year-round* to find quick, accurate solutions to production and procurement problems.

WHO READS IT?

The new edition will have the same circulation as Modern Plastics magazine. Currently the figure stands at 29,000—an all time high.

This all-paid circulation covers the two basic areas of the market:

1. The "end-users" of plastics. Fully half of the Encyclopedia's total audience are manufacturers in other industries (*not* the plastics industry) who use plastics and plastics parts in large volume. Many of them operate their own plastics-working facilities; others "farm out" their plastics converting operations to contract services; and many of them employ both methods.

2. The plastics industry itself. The Encyclopedia literally "blankets" the industry; the contract converters of plastics materials (molders, extruders, fabricators, etc.); the mold and die makers; the makers of resins and molding compounds; the makers of film, sheeting and laminates.

WHAT DO THESE READERS BUY?

A glance through this issue of the magazine will give you a fairly good cross-section of the kinds of materials, supplies, services and equipment that users of plastics buy. Basic purchases include all of the following:

Chemicals and Materials

adhesives • organosols • coatings • solvents • extenders • colorants • plastisols • plasticizers • stabilizers • laminates • dyes • saturating papers • glass fibre • wetting agents • synthetic resins • mold steels • fillers • lubricants

Equipment

hydraulic systems • scales • granulators • drills • buffers & polishers • extruders • mixers • drill presses • pyrometers • accumulators • cutting tools • heat sealers • lathes • mills • grinders • embossers • molding presses • timers • calenders • duplicators • slitters • control instruments • hobbing presses • motors • ovens • heating elements.

Services

deep drawing • assembling • postforming • hobbing • fabricating • plating • embossing • molding • decorating • laminating • mold making.

WHAT KIND OF ADS WORKS BEST?

Readers of Modern Plastics Encyclopedia issue want detailed, usable facts, not broad claims or fancy artwork. When they turn to the Encyclopedia Issue, they're getting down to "brass tacks"—comparing, evaluating, making buying selections.

Here are characteristic reader comments as reported by a leading research firm:

". . . need more technical data"
". . . give an idea of price range"
". . . more data on actual applications"
". . . give more complete physical and chemical properties."
". . . be specific in performance of machinery"
". . . too many ads have incomplete data"
". . . advertising is too general"

ORDER ADVERTISING SPACE NOW!

MODERN PLASTICS ENCYCLOPEDIA ISSUE
575 Madison Avenue, New York 22, N. Y.

☐ Please send me full details about the Encyclopedia Issue.

☐ Reserve space for me in the Encyclopedia Issue in the amount I've encircled at right.

Name ....

Company ....

Address ....

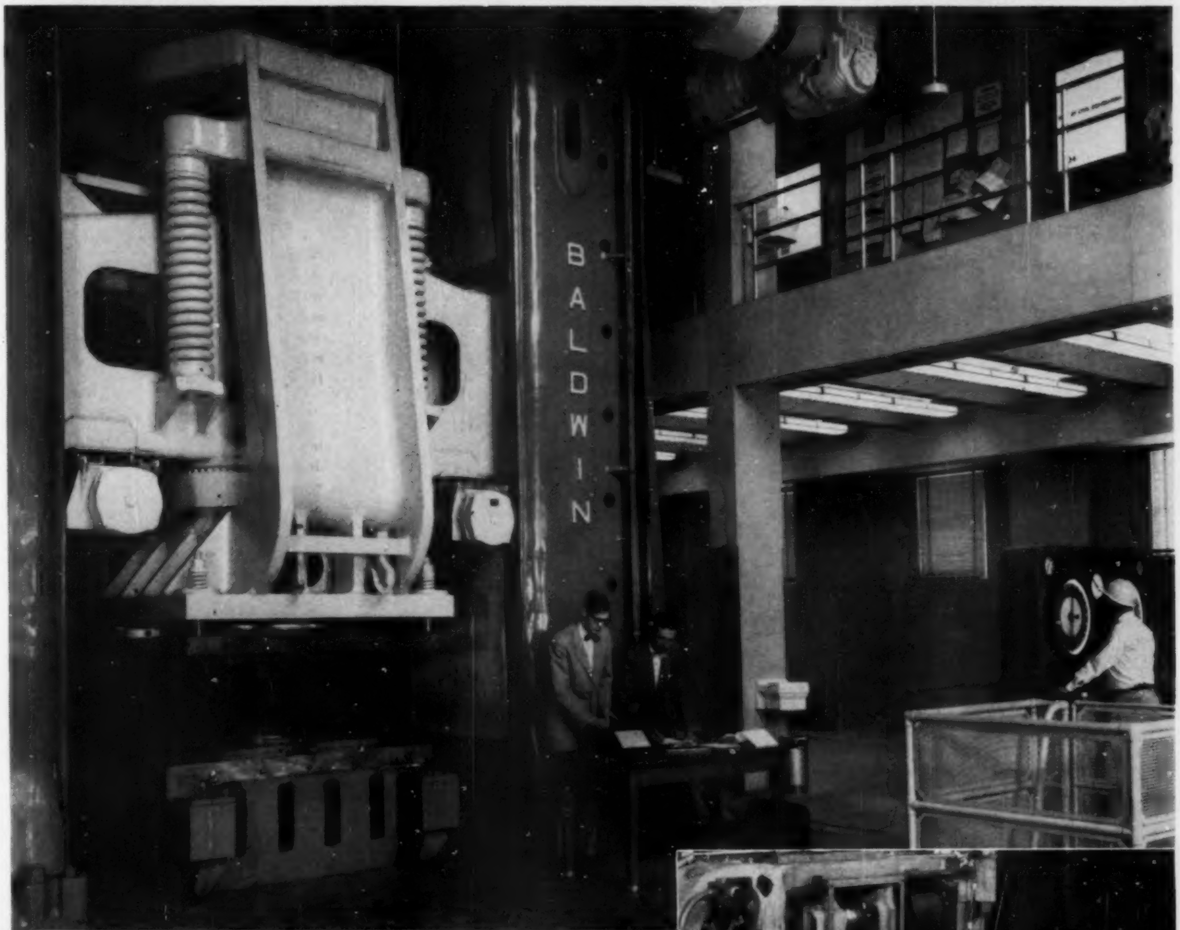
Space	Basic Rate*
Two pages	$1250
One page	635
Two-thirds page	505
One-half page	400
One-third page	315
One-quarter page	250

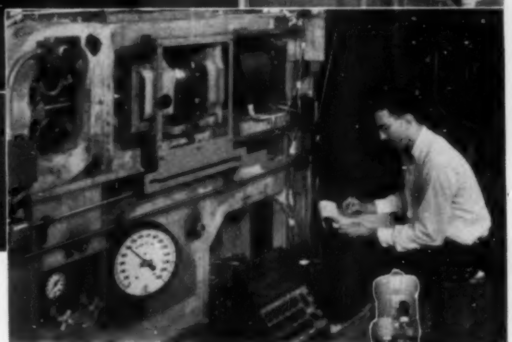
*** Lower rates apply to regular advertisers in Modern Plastics magazine. Ask for details.**

NEXT EDITION BEING READIED

It's time now to reserve the advertising space you'll need in the next edition. The final deadline for advertising matter itself—June 20th—is not too far off, especially in view of the careful planning and preparation that your "tell-all" advertisement should be given in order to make it of greatest value to readers.

A NEW STEP IN LESTER STANDARDS





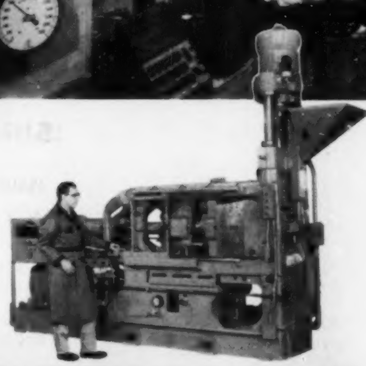
Read how 5,000,000 Lb. University Test Backs Up LESTER Locking Ratings...

A machined ring is squeezed between the jaws of a giant testing machine (capable of exerting 5 million pounds of pressure) at Lehigh University. Readings at various pressures are taken by an independent engineer. This ring is, in turn, locked between the platens of our machines and the comparison readings certify the clamping tonnage.

Why do we do it?

Because we know that the heart of controlling the quality of molded parts is the ability of the machine to develop and *hold* its full rated locking tonnage. Only with the one-piece cast alloy frame, an exclusive feature of Lester machines, is this tonnage assured for the life of the machine. No torque, no twist, no wear, no adjustment. Just rigid, dependable, *certified* clamping tonnage.

WRITE TODAY FOR FULL SPECIFICATIONS ON THE LESTER OF YOUR CHOICE



LESTER-PHOENIX, INC.

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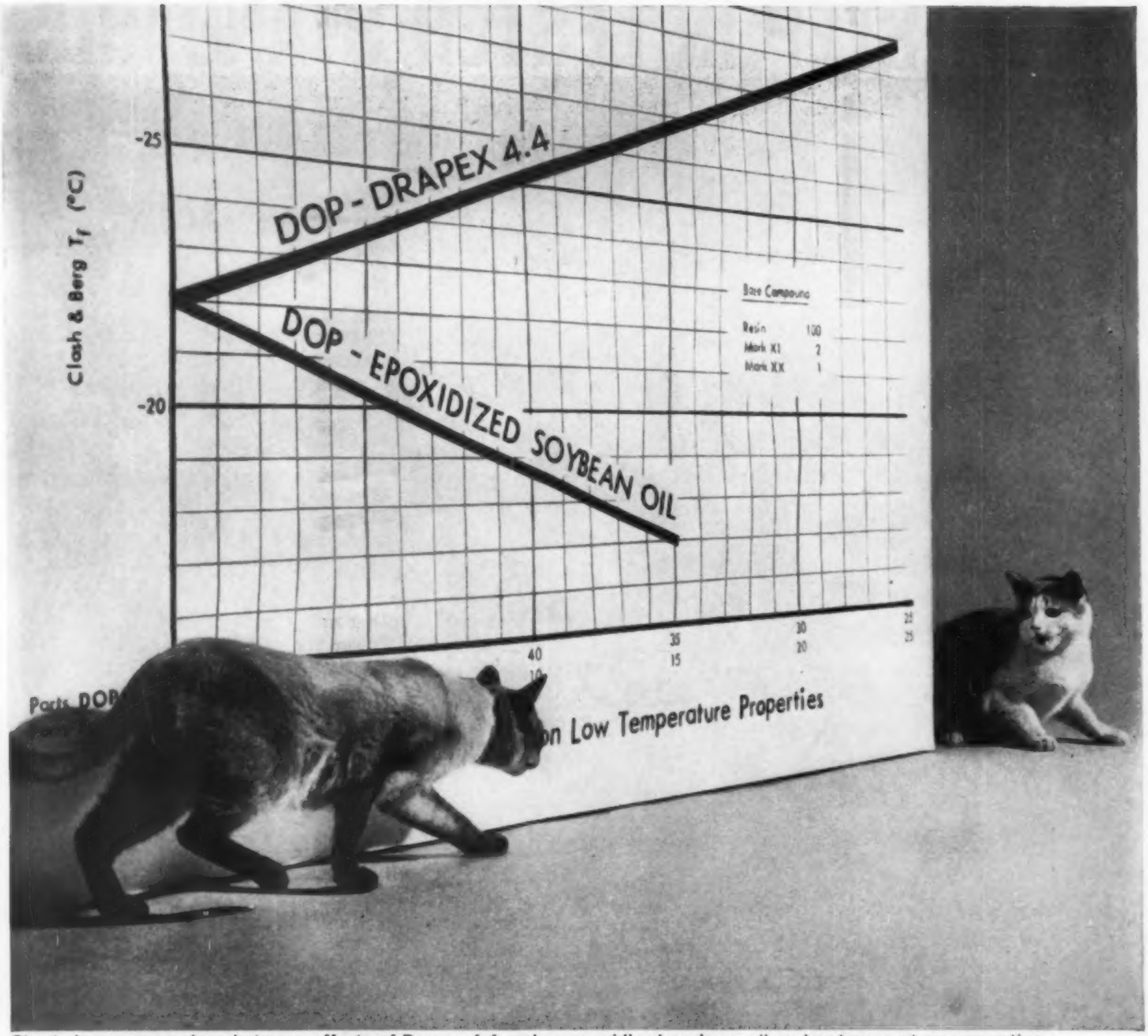

Chart shows comparison between effects of Drapex 4.4 and an epoxidized soybean oil on low temperature properties. Low temperature flexibility is a major advantage of Drapex 4.4.

PURE-BRED EPOXY... AT AN ALLEY-CAT PRICE!

There's a blue-ribbon champion in epoxy plasticizers — Argus' Drapex 4.4! At its new, reduced price, you can replace ordinary epoxy plasticizers with Drapex 4.4 in your vinyl formulations, with the following important advantages:

1. **Low temperature flexibility (see chart above).**
2. **Low volatility.**
3. **Improved heat and light stability.**
4. **Low viscosity and viscosity stability in plastisols.**
5. **Ease of handling (due to low viscosity and low freezing point).**
6. **Good weatherability.**

Argus research has steadily widened the applications of Drapex 4.4 until it now actually costs *less* than other quality epoxies. Moreover, the lower specific gravity of Drapex 4.4 makes it go farther, so that in volume use it costs less than the cheapest competitive epoxy.

For complete information on Drapex 4.4 (and its sister product, Drapex 3.2), write for Technical Bulletin #3.

ARGUS CHEMICAL CORPORATION / New York and Cleveland

Main Office: 633 Court Street, Brooklyn 31, N. Y. Branch: Frederick Building, Cleveland 15, Ohio

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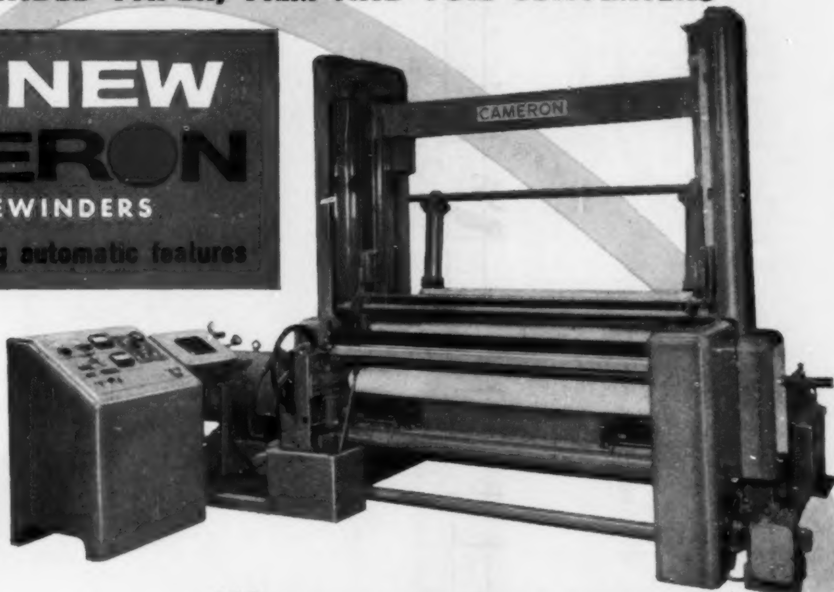
with new cost-cutting automatic features

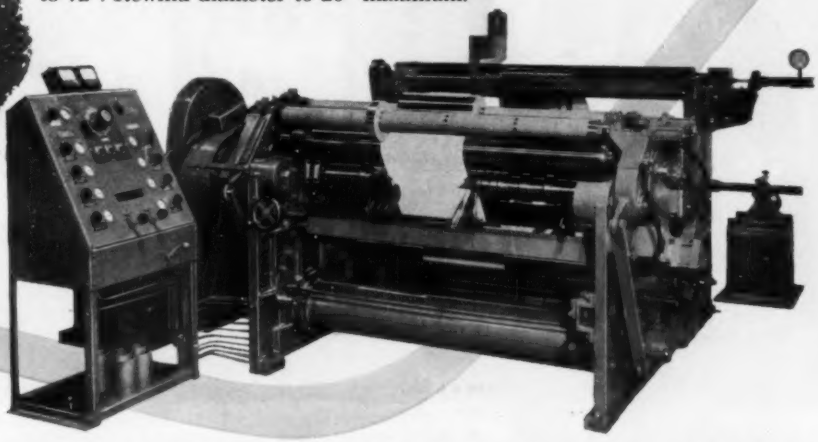


420 SERIES

420 For paper and other materials. Shear-cut or score-cut. Panelboard control station. Power transmission through positive toothed belts. Electric riding roll lift available. Speeds to 3500 fpm*. Widths 42" to 82". Rewind diameter 42" maximum.

620 For off-caliper materials including paper, film, foil and laminates. Score-cut, shear-cut, or razor-cut slitting, singly or in combination. Speeds to 1000 fpm*. Trim widths 32" to 72". Rewind diameter to 20" maximum.

620 SERIES



SEE CAMERON
BOOTH 1435
National Packaging Exposition
May 26 — May 30
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Just when you need them most, we are proud to announce two great new Cameron machines, designed by our team of specialists to put *you* way out front in roll production. They give you new labor-saving automatic and semi-automatic production features, and new, superior web controls to improve the quality and reduce the cost of your roll products. They provide new versatility for quick, easy set-ups, fitted to the exact requirements of the newest papers, films, foils and laminates.

A Cameron specialist will be happy to call at your plant to show how the 420 or the 620 can be custom-fitted to your needs. It will pay you to write, wire or telephone for an early appointment.

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**Speed depends on width, number of cuts, and characteristics of material.*

Built by Cameron's team of specialists

AA-389

50 years devoted exclusively to the design and manufacture of slitting and roll winding equipment.

*WITH PFIZER CITROFLEX® A-4... nontoxic, odorless plasticizer

Citroflex A-4 is accepted by the Food and Drug Administration, the Bureau of Animal Industry, and the Office of the Quartermaster General as a component of plastic film wraps **for both fatty and nonfatty foods.** Its toxicological safety is unsurpassed.

It's odorless, and it makes vinyls outstandingly low in extractable taste, too.

It has excellent viscosity stability and superior heat stability in polyvinyl chloride plastisols...**unusual efficiency** as plasticizer for synthetic resin adhesives and polyvinyl chloride coatings for paper board products. Lower amounts are needed than with other plasticizers to achieve the same heat-sealing temperatures.

Vinyl coatings formulated using Pfizer Citroflex A-4 have **high gloss finishes.**

Manufacturing Chemists for Over 100 Years

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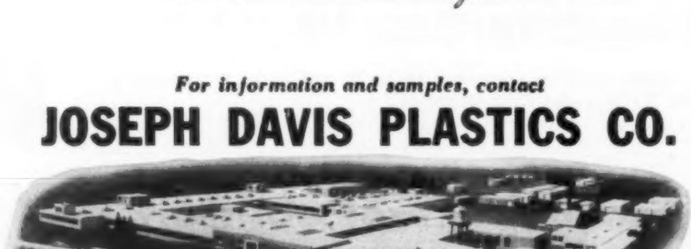

Hospitals will welcome this new lightweight sterilizer tray made of heat-resistant MARLEX . . . withstands sterilizer temperatures up to 250° F. for hours!

MARLEX tote boxes filled with chickens moving into this quick-freezer easily withstand repeated freezing and steam cleaning, as well as the usual severe production-line handling.

The best tote boxes are made of MARLEX*

RIGID POLYETHYLENE

. . . lightweight, unbreakable, low in cost!

"We picked Marlex because it has what it takes to deliver satisfactory service in restaurants, cafeterias, hotels, hospitals, and the institutional food field," says Daniel Bloomfield of Bloomfield Industries, 4546 West 47th Street, Chicago 32, Ill.

"Here is a tough, rugged plastic that is completely sanitary," Mr. Bloomfield points out. "You can put our new Marlex All-Purpose Dish Boxes and Silverware Trays through commercial cleansing procedures.

"Marlex doesn't stain from oils, fats or greases. It won't dent, either. So this equipment keeps its good looks. And the price is right."

Injection-molded restaurant equipment is just one of many profitable applications for Marlex polyethylene. No other type of material can serve so well and so economically in so many different uses.

For more information, get in touch with your local Marlex sales representative.

*MARLEX is a trademark for Phillips family of olefin polymers.

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● This Isophthalic resin reinforced plastic duct combines light weight with high strength and superior resistance to corrosion. Fabricated by Peterson Products of San Mateo, California.

Super-tough plastic duct ...another FIRST for ISOPHTHALIC resins

Another new accomplishment with Isophthalic resins was the production of tough, light-weight ducting for a fume control system. Isophthalic resins were selected because of their superior performance. In this case, the plant required ducting that would last for years while in continuous service for controlling corrosive acid fumes. The answer proved to be an Isophthalic based plastic with superior resistance to corrosion.

This fiber glass duct, 25 to 36" in diameter, 5/16-inch thick, fabricated in 3 sections totaling 130 feet, is extremely tough, yet light-weight—only 3000 pounds for the entire truck load shown above. A stronger laminate as well as better adhesion to glass fibers was accomplished with Isophthalic resins.

Superior wetting properties of Isophthalic resins reduced fabricating time and costs; the sections were quickly fabricated by using a contact layup over a male mandrel.

Isophthalic polyester resins with the epoxy strengths are continually solving tough application problems, providing the reinforced plastics manufacturer with new, years-ahead products. Contact your resin supplier or Oronite directly—see how Isophthalic resins can benefit the products you manufacture or market.

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4833

The Plastiscope*

May 1958

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Polyethylene for bread wrappers. The first breakthrough for polyethylene film as a wrapping material for bakery goods has been accomplished by Crown Zellerbach Corp. through the use of a new film formulation and a special $1500 heat-sealing attachment for standard bread wrapping machines. Heretofore, it had been commercially impractical to seal polyethylene film as an overwrap on bakery goods; when this development achieves nationwide acceptance, film consumption should grow by millions of pounds. It is claimed that bakers' cost for the new film, known as Crown-Seal, will run from 25 to 35% less than for cellophane. Western-Waxide, a division of Crown Zellerbach, will sell and install the wrapping attachment and is stated to have developed special end labels and outsert bands that provide a better seal and easier opening. The new bread wrap has already been adopted by Fluhrer Baking Co., Eureka, Calif.

The material used in Crown-Seal film has been formulated by Spencer Chemical Co. No detailed information is as yet available, but it is obvious that the formulation is for a relatively high-density material, since stiffness is reported to be one of the properties required for putting the film through the machine. However, because cost is an important factor, the density is probably not too high; cost increases as density goes up. A guess would put the density in the realm of 0.930, where properties of clarity, surface gloss, permeability, slip, and anti-blocking would be obtainable along with the required stiffness. Spencer expects to develop other important over-wrap applications from its family of medium-density resins in the near future and asserts that each application requires a different formulation.

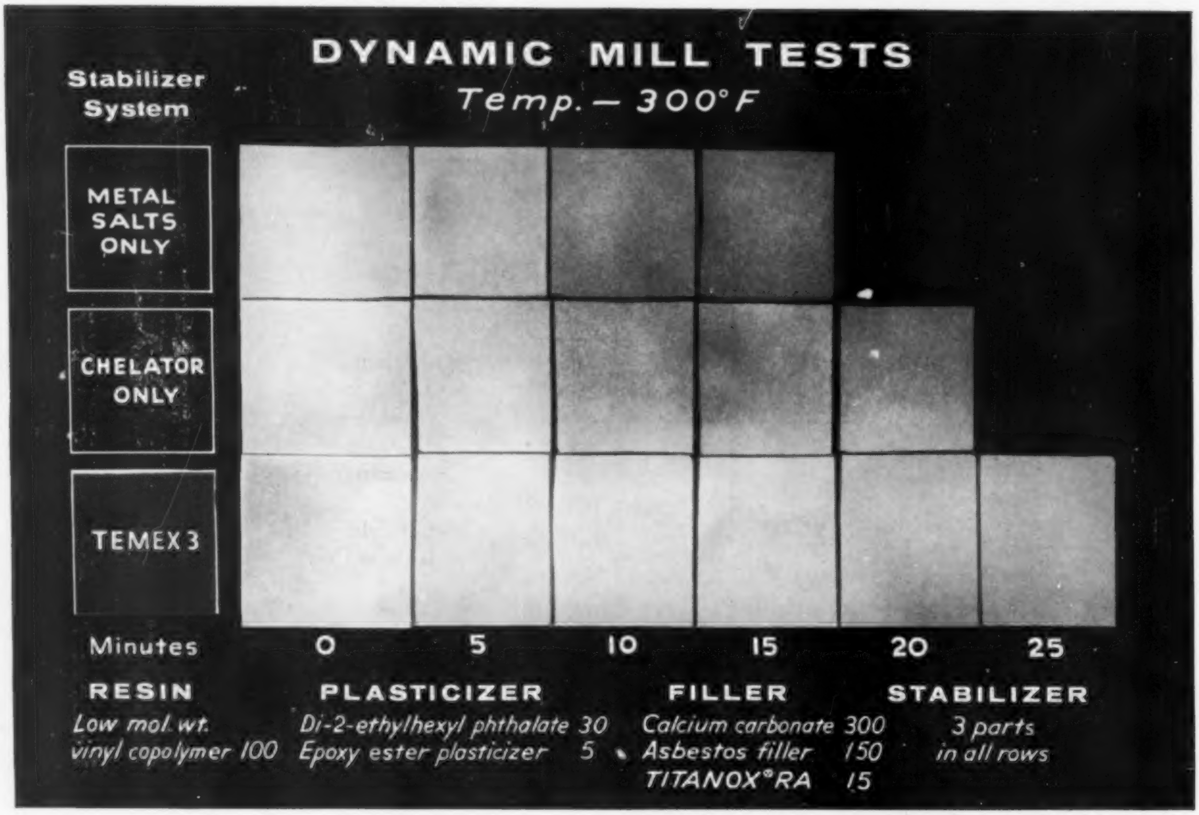
A complete illustrated discussion of the bread-wrap development will be published in the June issue of MODERN PLASTICS.

Third type of urethane foam. There seems to have been some confusion concerning the recently announced Pittsburgh Plate Glass Co's. dimer-acid polyester resin for use in formulating urethane foam. P.P.G. does not make foam but sells the resin to formulators. The dimer-acid polyester, Selectrofoam 6207, takes the place of adipic acid polyester used in conventional polyester-isocyanate foams. It is formulated by the same "one-shot" system.

Polyether foams, using glycols instead of polyesters, require a more complicated foaming technique. The hydroxyl source or glycol is first prereacted with isocyanate to produce a prepolymer and is later mixed with the various additives.

The advantage claimed for Selectrofoam 6207 is that it has overcome the compression-deflection characteristics of previous adipic acid-based

*Reg. U.S. Pat. Off.



National Lead Company Research Laboratories Test #5145

Proof:

Double-acting "Dutch Boy" Temex 3 does most for color control in vinyl flooring

... opens way to brighter and longer lasting hues as well

What a difference in color retention between the three asbestos-filled flooring stocks pictured above!

With "Dutch Boy" Temex* 3 stabilizer, initial color is retained 25 minutes or more. That's because Temex 3 has a unique double action ... provides improved metal salt stabilization *plus* excellent chelation.

Double action boosts color control in three other important ways

In addition to greatly improved color retention, Temex 3 stabilizer provides three other significant controls over color.

Improves tint development. With lighter base stocks, tints develop brighter and truer hues. Critical color values are easier to obtain.

Broadens the list of usable tints. The low reactivity of Temex 3 stabilizer does away with pinking, bluing and other undesirable color shifts. You are free to use both lighter and stronger tints.

Prevents color degradation from reworked trim. As the test above shows, even extended heat histories do not darken Temex 3 stocks.

Double action lengthens color life, too

Once flooring is laid, "Dutch Boy" Temex 3 stabilizer continues to preserve beauty of flooring. It protects against attack of ultraviolet light. Stabilizer staining by sulfides is eliminated. Its protective action continues through long-term washing and wear.

National Lead research has developed 20 other outstanding stabilizers for various types of vinyl stock. Among them, two more that are widely used in asbestos flooring stock ... "Dutch Boy" Tribase and Normasal stabilizers ... and one for non-asbestos flooring ... "Dutch Boy" Clarite® A stabilizer.

Each of these versatile "Dutch Boy" stabilizers simplifies processing and extends the life of specific vinyl products. Get the details in the latest "Dutch Boy" literature.

*Trademark

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The Plastiscope

(*Continued from page* 41)

urethanes and has just as good cushioning characteristics as polyether foam. Selectrofoam is said to be competitive with lowest cost foams, can be used at densities of 1.7 lb./cu. ft. compared with 2.2 lb. for other urethane foams, has controllable cell structure and excellent humid aging resistance, and will provide a range of formulations which result in foams ranging from extremely soft to moderately high load-bearing.

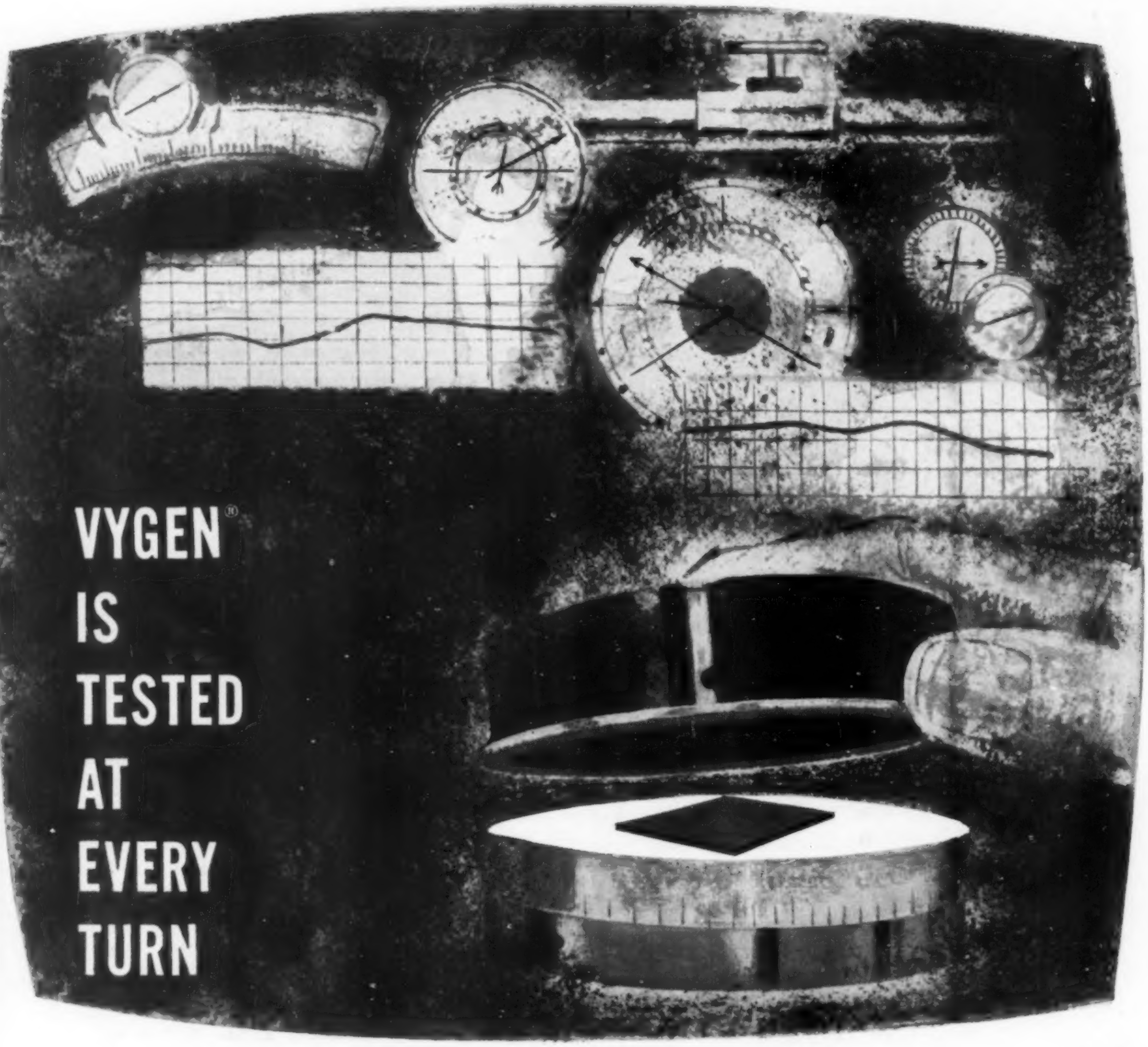
(A technical report on other work in the field of dimer acid polyesters for urethane foams appears on p. 145 of this issue.)

Bakelite now producing low-pressure-processed polyethylene. Latest of the new type polyethylene plants to start operation is the Bakelite 30 million-lb.-annual-capacity facility at Institute, W. Va., where production is based on Ziegler-type catalysis. A second plant for low-pressure-processed or high-density polyethylene (25 million-lb. capacity) will be ready soon at Seadrift, Texas. This second plant will produce Phillips-type resins which have a density ranging up to 0.960. The Ziegler type generally ranges up to 0.950. Bakelite's high-pressure resins are of various densities ranging generally from 0.915 to 0.927. Thus, the company line of polyethylenes will include both the lowest and highest densities now available. (More details appear on p. 238.)

A significant feature in the Bakelite announcement was that products made from its new high-density material are now actually in production on a commercial scale. The company is showing a blow molded industrial soap dispenser and an injection molded case for an atomizer, both by Wheaton Plastics, Mays Landing, N. J., as well as a step-on garbage can by Dapol, a helmet guard by Martindell, an Owens-Illinois blow molded bottle, and other applications, including monofilaments, all rolling off production lines. The soap dispenser is especially significant since the customer wanted a bottle-shaped container that would *not* squeeze.

The company reports that there are no complaints of stress cracking, and that molding cycles are a few seconds shorter than for conventional polyethylene because of greater stiffness. More than 1 million lb. of the new Bakelite material has been used for experimental and development work during a two-year study; the resulting property data and fabrication information are available to processors.

Synthetic resin sales trace irregular course. The decline in resin sales that started last November hasn't shown much sign of a sizable recovery across the board. But there are bright spots here and there, as in polyethylene, and some producers make such off-hand statements as "March was 10% better than February" and "April looks 10% better than March." The uncertain factor, however, is that while February was abnormally low, the bottom didn't drop out by any means. A point to remember in relation to several leading volume plastics is that prices have been receding; consequently, dollars are down more than volume. The bite hurts in either case, but a dollar loss is more immediately distressing and tends to over-emphasize any volume loss. As a result, there is going to be considerable talk of "poor" business even if sales volume shows a steady increase. (*To page* 45)



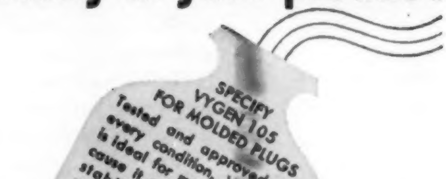
. . . to assure top quality and uniformity in your product

From raw materials through glass-lined equipment to your plant — every phase of the Vygen production operation is planned and supervised through extensive testing to give you a perfect product. Outstanding quality and absolute uniformity makes Vygen resins and compounds right for any job, regardless of size, equipment or technique. Vygen is carefully checked before you get it, to make sure your finished goods are the very finest.

Both application-tested and UL-approved, these two members of the Vygen family are ideally suited for wire insulation and jacketing. Specify the one that fits your requirements.

VYGEN 120 resin — For fast, flawless dry-blend extrusion, using monomeric or polymeric plasticizers. It has a narrow range of particle-size distribution, fast rate of solvation, and outstanding heat stability.

VYGEN 6812 compound — Pelletized, ready for extrusion in black, white, or natural. Proved for 60° C T&TW in oil and 80° C appliance wiring applications, this material has a specific gravity of 1.32 and takes to the toughest jobs with ease.



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The Plastiscope

(*Continued from page 43*)

Will sales in 1958 come close to 1957? The MODERN PLASTICS preliminary estimate for consumption of synthetic resins and cellulosics in 1957 was 3,877,000,000 lb. compared with 3,850,000,000 lb. in 1956. This is an adjusted figure based on preliminary Tariff Commission monthly reports and includes captive-produced materials, such as alkyds, phenolic laminates, and certain vinyls, but does not include epoxies and sales of certain producers who report on an annual basis only. However, it is close enough to give a fair picture of the past two years. Without polyethylene, the rest of the industry, including the alkyds, might decline 150 million lb. or more in 1958 if an estimate is based on first quarter figures, but polyethylene is expected to increase 100 or more million lb. in 1958; besides, most people are gambling that the first quarter will be the lowest of the year. The guess in some areas is that third and fourth quarter business this year will bring total sales for all synthetics up to the 1957 volume because of the expected big polyethylene increase—unless the alkyds do a worse tailspin than in 1957.

How are various resins faring? **Cellulosics** producers assert that sales have held up well. In November and December, monthly sales were about 8 million lb., which is a very good figure. But January was less than 6.5 million and February well under that. January and February of 1957 were 7 million lb. each. A decline in butyrate for automotive use may have been responsible, because most other applications are moving normally.

Phenolic molding material is creeping back up after the big 25 million-lb. splurge last October and the extremely low November and December outputs. A 13 million-lb. month in January 1958 compares with 16.7 in January 1957. March was slightly better than January. Total first quarter sales will be under the first quarter of 1957 but about the same as the last quarter.

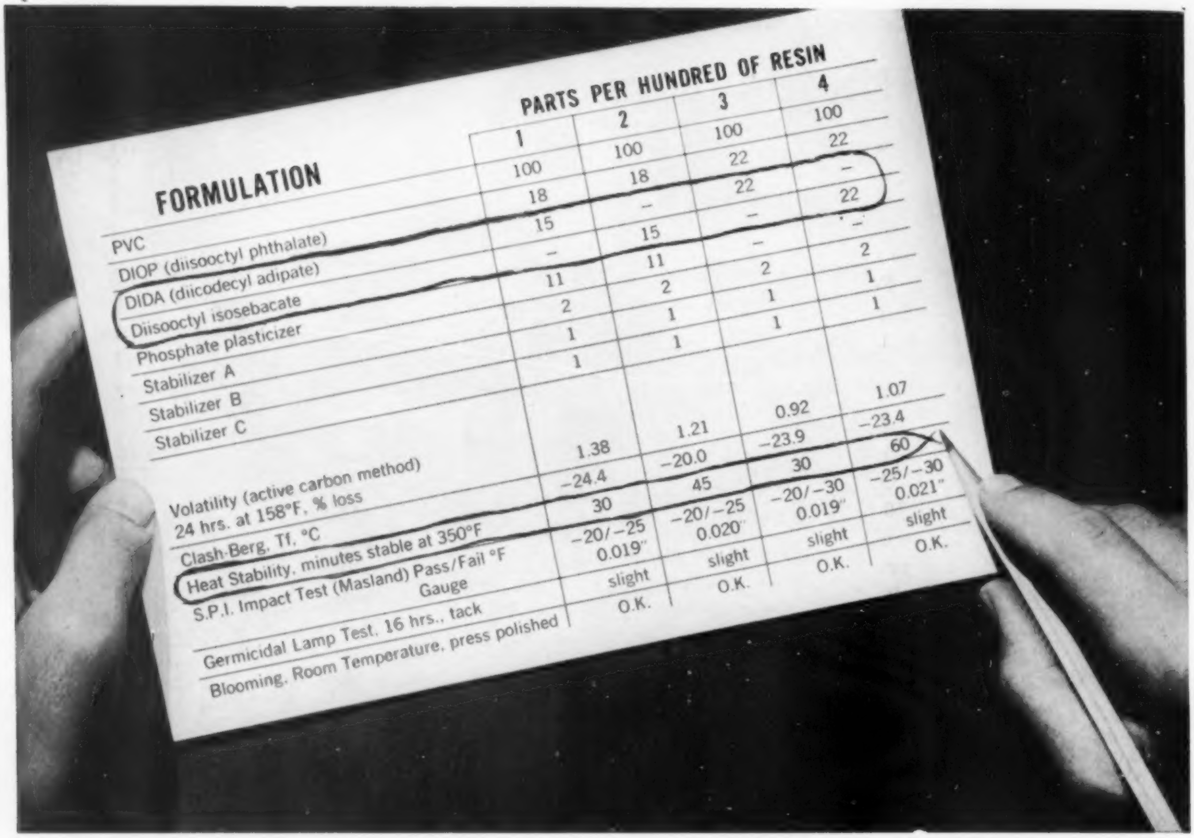
Urea and **melamine** are holding their own compared with 1957. Molding material may even be higher.

Styrene resins are down a few million pounds per month under 1957, according to estimators. January sales in 1958 were 31.6 million lb. compared with 36 million in 1957. February probably dropped below 30 million. March and April are expected to be from 31 to 33 million compared with 37 and 36 million in 1957. A price hassle over the recent ¾¢ reduction has undoubtedly interfered with sales of general-purpose material. Impact material sales have suffered from the decline in refrigerator production.

Polyesters are doing well. March is believed to have been even better than last October's 7 million lb., with an estimated sales volume of 7.2 million lb. compared with 7.8 a year ago.

Polyethylene was 62 million lb. in January 1958 compared with 53 million in 1957. February is thought to have dropped to about 50 million, but March may have been up to 70 million. Off-grade sales were extremely high in March since there is some possibility of a more firm price for such material in the future and molders loaded up. April may go down to 45 or 50 million because of heavy buying in March, but the crystal ball says polyethylene sales in general will be 100 million lb. more in 1958 than in 1957.

Methyl methacrylate molding powder, with over half its sales going to automotive uses, has been hard hit. January sales were estimated as even



FORMULATION	PARTS PER HUNDRED OF RESIN 1	2	3	4
PVC	100	100	100	100
DIOP (diisooctyl phthalate)	18	18	22	22
DIDA (diicodecyl adipate)	15	–	22	–
Diisooctyl isosebacate	–	15	–	22
Phosphate plasticizer	11	11	–	–
Stabilizer A	2	2	2	2
Stabilizer B	1	1	1	1
Stabilizer C	1	1	1	1
Volatility (active carbon method) 24 hrs. at 158°F, % loss	1.38	1.21	0.92	1.07
Clash-Berg, Tf, °C	–24.4	–20.0	–23.9	–23.4
Heat Stability, minutes stable at 350°F	30	45	30	60
S.P.I. Impact Test (Masland) Pass/Fail °F	–20/–25	–20/–25	–20/–30	–25/–30
Gauge	0.019"	0.020"	0.019"	0.021"
Germicidal Lamp Test, 16 hrs., tack	slight	slight	slight	slight
Blooming, Room Temperature, press polished	O.K.	O.K.	O.K.	O.K.

This test shows

HEAT STABILITY OF PLASTICIZED VINYLS IS IMPROVED BY ESTERS OF ISOSEBACIC® ACID

ISOSEBACIC® acid, a new synthetic 10-carbon dibasic acid, has many plus values that recommend it as an intermediate for vinyl plasticizers. You'll see one example in the above figures—results of a test made recently by a processor of vinyl plastic film.

Read down columns 1 and 2. *Heat stability improves 50%* (from 30 minutes to 45 minutes) when 15 parts of an ISOSEBACIC acid ester replace 15 parts of an adipic ester in this formulation.

Read down columns 3 and 4 and you see an even more striking result in a test where higher ester levels were used. ISOSEBACIC acid ester actually *improves heat stability 100%* (from 30 minutes to 60 minutes).

Among the plus properties of ISOSEBACIC acid esters as vinyl plasticizers are:

- Low color
- Low odor
- Low oil extraction
- Low soapy water extraction

And ISOSEBACIC acid has other uses in the plastics field. It can be used as an intermediate for polyamides, polyesters, polyurethanes and alkyd resins. If you make any one of them—or a vinyl plasticizer—it will pay you to evaluate U.S.I. ISOSEBACIC acid. Send today for data sheets and samples.

CHEMICAL PROPERTIES

ISOSEBACIC acid is a mixture of C-10 dibasic acids—2-ethyl suberic; 2,5-diethyl adipic; and sebacic. It undergoes typical reactions of dibasic acids. It yields acid and neutral esters, acid and neutral salts. Relatively stable, it is not oxidized by air at ordinary temperatures.

PHYSICAL PROPERTIES

Molecular weight	202.24
Combining weight	101.12
Density (80°C)	1.025 g/ml 8.55 #/gal
Melt viscosity (80°C)	78.5 centipoises
Specific heat of vapor (226°C)	0.34 cal/g (est.)
Heat of vaporization (226°C)	107 cal/g
Specific heat of solid (24°C)	0.33 cal/g
Heat of Combustion	1296 K cal/mole
Flash point (closed cup)	430°F.
Ionization constant at 25°C	$K_1 = 3.5 \times 10^{-5}$ $K_2 = 5.1 \times 10^{-6}$

U.S. INDUSTRIAL CHEMICALS CO.
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The Plastiscope

(*Continued from page* 45)

lower than December. February was up slightly and March was perhaps 5% over February but much lower than ordinarily expected in March. A marked increase in jewelry sales has helped. Dollar earnings have perhaps been lowest since 1951. Methacrylate sheet has been seriously off since last October.

Vinyl most difficult to estimate. Because vinyl chloride reaches into so many phases of industry, many complexities are encountered in estimating its current position. Of course, it was seriously affected by the automobile decline; a total of 8 to 10 lb. of vinyl is used per car. But there were also other important factors. Wire coating for construction was down partially because of uncertainties in the price of copper which resulted in big inventories by distributors. Film, largely a consumer goods item in contrast to durable goods items already mentioned, has been down for several months.

Several favorable factors help to offset the losses. Plastisols are holding up well despite a 25% drop in fabric coating. New uses like hobby horses take a lot of material. Toilet seats are another volume possibility. And plastisol for floor covering is gathering headway. Vinyl-asbestos floor covering is also continuing to grow even though floor coverings in general are down. Inflatables are picking up more volume.

Thus even though vinyl chloride slipped from 59 million lb. in October 1957 to 40 million in December, 44 million in January, and the lowest in three years in February, it is still big business. An increase of 5 to 10% in March and a similar upswing in April was expected by some producers, but there is certainly no unanimity on the cheerfulness of this latter note.

New impact phenolic molding compound. Durez 18683 is a new 24½¢ impact phenolic introduced by Durez Plastics Div., Hooker Electrochemical Co. It is a sisal-filled, two-stage compound in *nodular form*. Heretofore, sisal compounds had been in mat form. It is reported that this low-cost new material can be molded at the same pressures as general-purpose phenolics, using standard dies, and can be preformed automatically in horizontal preforming machines. Curing time is the same as for general-purpose compounds. It is dimensionally stable and can be used in difficult applications that require "wet inside-dry outside" conditions, according to the producer. It has an impact strength of 1.4 ft.-lb./in. and is designed for applications which require a long flow.

Vinyl fluoride film. Another new film is now under evaluation by Du Pont, but there has been no decision on whether it will ever be put on the market. It is based on vinyl fluoride, known for many years as a material with remarkable properties but which, until now, no one has been able to harness because of production difficulties. It is being considered as a laminating film and has particularly good weatherability and toughness. Details are on page 238.

For additional and more detailed news see Section 2, starting on p. 238.

Why shouldn't we be interested

IN PARTNERSHIP INSURANCE?

"After all, we know the future of our families may depend upon it."

By law, the death of a partner means the total dissolution of the partnership organization. It could bring business activity to a complete standstill.

The result: possible financial chaos to the business and extreme hardship to the families involved.

Ætna Life's Business Planning Service can help prevent this . . . can provide in advance for a smooth and orderly transfer of the business.

Thoroughly trained representatives in 91 agencies from coast to coast are ready to help you and your attorneys through Ætna Life's unusual Business Planning Service.

ÆTNA BUSINESS LIFE INSURANCE PLANS ARE SPECIALLY DESIGNED . . .

- To preserve PARTNERSHIP values when death comes to any partner.
- To preserve SOLE PROPRIETORSHIPS for heirs or selected employees.
- To preserve ownership values when death comes to any stockholder in a CLOSE CORPORATION.
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Gentlemen:

Please send me a copy of your new business life insurance booklet "Will This Man Take Your Business With Him When He Dies?"

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Nature's colors are rivaled by Du Pont Pigments

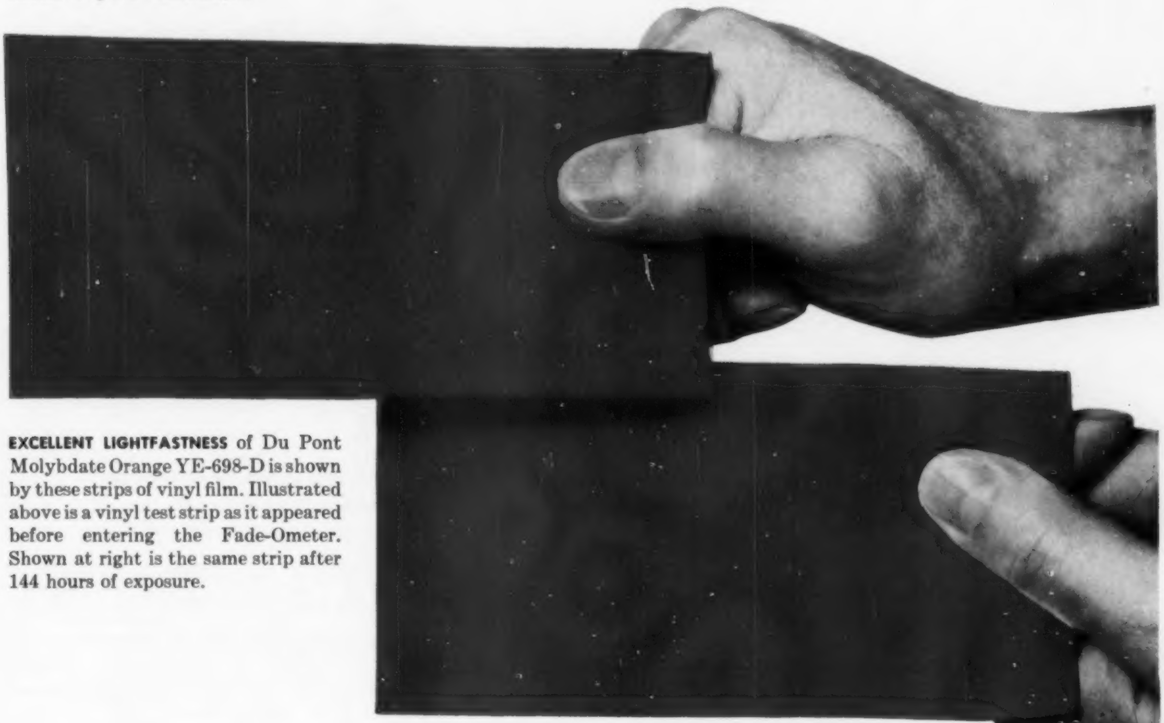
You capture the color appeal of the angelfish with lightfast Du Pont Molybdate Oranges and Chrome Yellows

Du Pont offers you an extensive line of Molybdate Oranges and Chrome Yellows for interblends yielding a wide shade range of opaque color in plastic systems. The red shade Molybdate Orange YE-698-D and the yellow shade YE-421-D provide excellent tinting strength . . . ease of dispersion. You can expect this same excellent performance in Chrome Yellow Light Y-433-D and Medium Y-469-D.

STRONG, BRILLIANT REDS—For ease of grinding and resistance to migration and crocking, use Watchung Reds in your vinyl systems. With a complete shade range to choose from—Watchung Red Light RT-618-D to Maroon RT-710-D—you can meet the most critical color needs of your customers.

LIGHTFAST GREENS AND BLUES—Yellow shade Monastral® Green GT-751-D provides excellent lightfastness, brilliance and crock resistance for your pastel-colored plastics. You can expect these same properties with Du Pont's Monastral® Blues.

COLOR STANDARDIZATION—You can rely on the batch-to-batch uniformity of all Du Pont Pigments to simplify color matching . . . with both pigment colors and Ti-Pure® titanium dioxide pigments. Technical assistance from Du Pont is always at your call. For information, consult your Du Pont Pigments representative, or write: E. I. du Pont de Nemours & Co. (Inc.), Pigments Dept., Wilmington 98, Delaware.



EXCELLENT LIGHTFASTNESS of Du Pont Molybdate Orange YE-698-D is shown by these strips of vinyl film. Illustrated above is a vinyl test strip as it appeared before entering the Fade-Ometer. Shown at right is the same strip after 144 hours of exposure.

Here are a few of the fine pigments in the Du Pont line offering the properties you require:

Ti-Pure® Titanium Dioxide
Green-Gold—Durable Organic Yellow
Monastral® Blues and Greens
Ramapo* Blues and Greens

Chrome Yellows
Molybdate Oranges
"Watchung" Reds
Pyrazolone Red

*DU PONT TRADEMARK

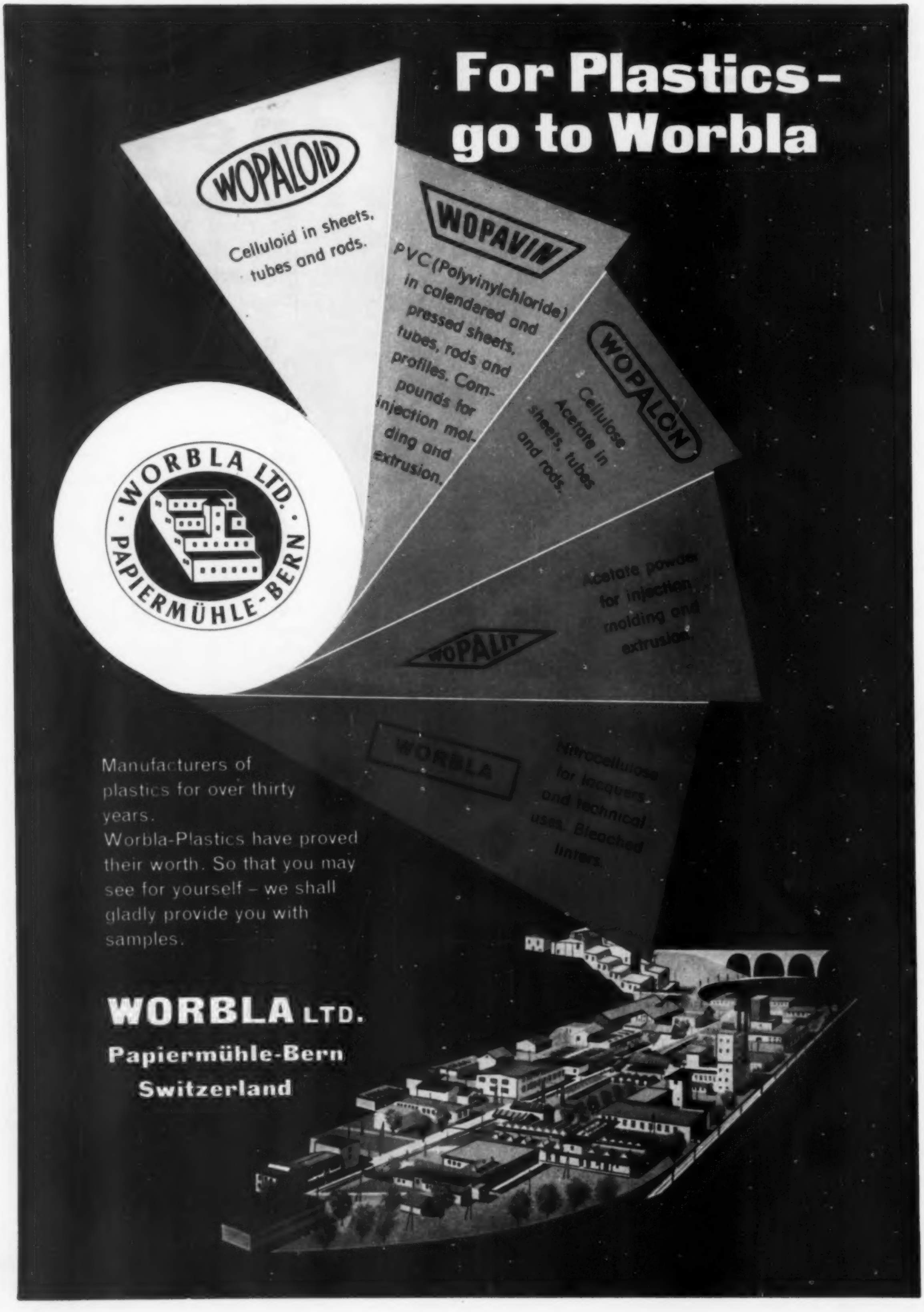
fine products everywhere

PIGMENTS DEPARTMENT

DU PONT

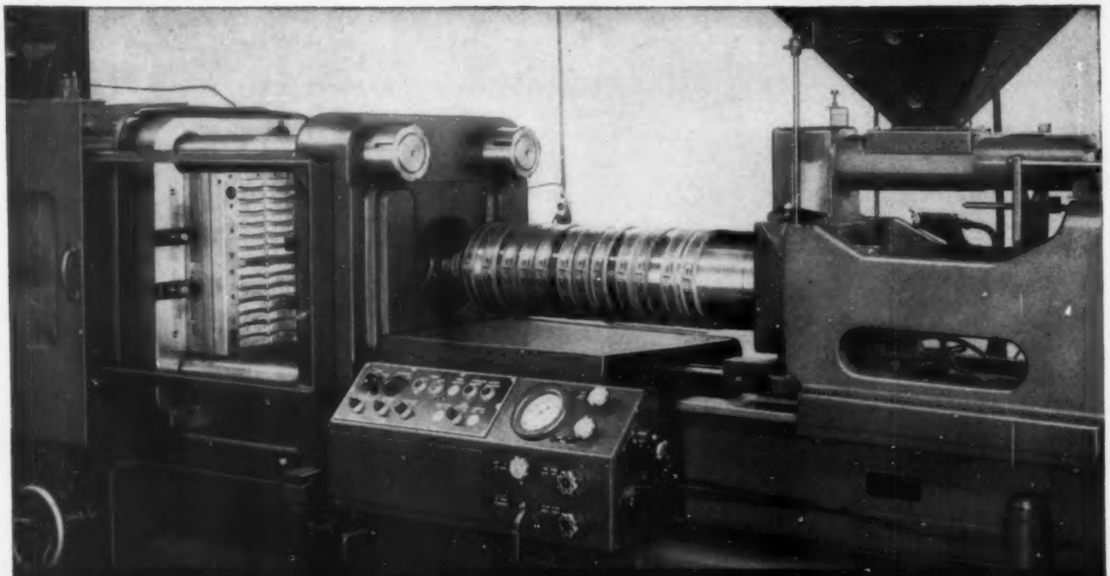
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY



For Plastics -
go to Worbla
WOPALOID
Celluloid in sheets, tubes and rods.
WOPAVIN
PVC (Polyvinylchloride) in calendered and pressed sheets, tubes, rods and profiles. Compounds for injection molding and extrusion.
WOPALON
Cellulose Acetate in sheets, tubes and rods.
WOPALIT
Acetate powder for injection molding and extrusion.
WORBLA
Nitrocellulose for lacquers and technical uses. Bleached linters.
WORBLA LTD. PAPIERMÜHLE-BERN
Manufacturers of plastics for over thirty years.
Worbla-Plastics have proved their worth. So that you may see for yourself – we shall gladly provide you with samples.
WORBLA LTD.
Papiermühle-Bern
Switzerland

NEW REED JUMBO HEATERS...



At Superior Comb Co., Leominster, Mass., this 300TA—12/16 oz. REED, equipped with a Jumbo heater, is running a 56-cavity comb mold for National Comb Co. On a similar 24-cavity styrene comb shot weighing 8½ oz., Superior cut cycle time 25% with this machine and increased production by over 1,000 combs per hour.

Now available on New REEDS . . .

JUMBO HEATING CYLINDERS

This new REED Jumbo, available as optional equipment, is the best heating cylinder you can get today. Another product of advanced Reed-Prentice engineering, the Jumbo is the only heater to give you all these advantages:

Greater capacity — The Jumbo is big, and built to handle more material per hour. You're assured of fast, thorough plasticizing with close, three-zone temperature control. Shrink-fit construction of torpedo means better heat transfer, and no drag on fins.

Faster molding — You run heavier shots, fill the mold faster, and cut cycle time. The Jumbo operates at lower temperatures, helps you reduce curing time in the mold.

Leakproof construction — REED engineers have developed a new, three-piece construction for the Jumbo. This means you have *only two seams,* and far less chance of leakage than with other heating cylinders.

Easy to clean — Special features make it easier to remove, disassemble and clean the Jumbo when necessary. With this new REED heating cylinder, you lower your heater maintenance.

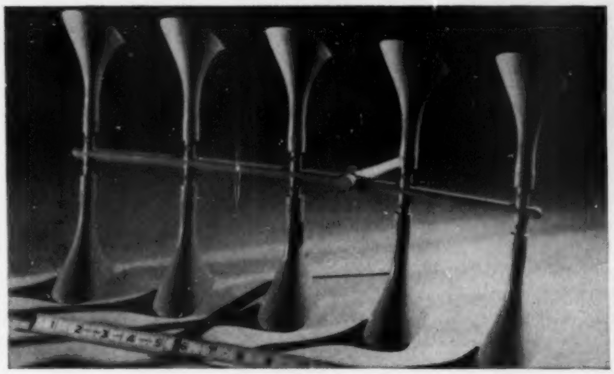
Jumbo heaters are available for these REEDS: 175T (and TL) — 4/6 oz.; 275T — 8/10 oz.; 300TA (and TL) — 12/16 oz.; 400 T — 16/20 oz. For further information, call your Reed-Prentice Sales Engineer today.

Engineered for Modern Molding

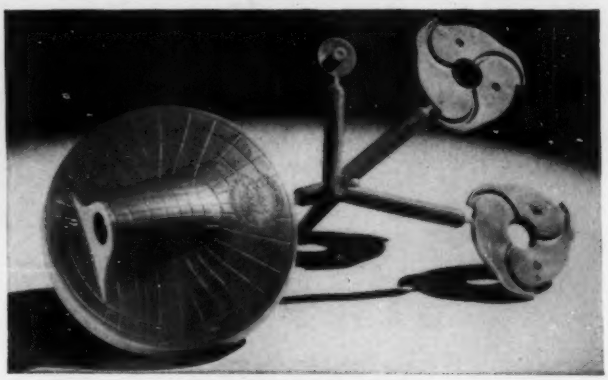
"WE'VE CHOSEN REEDS FOR OUR REPLACEMENT PROGRAM"

SAYS JOHN J. BACHNER,
President of Chicago Molded Products Corp.

"We focus our efforts on two main objectives — turning out superior molded parts and doing it in a way and at a price that saves money for our customers. We've built a reputation we're proud of on that policy. But we know we couldn't continue to do it, nor could we remain one of the country's top molders, with old equipment. That's why we have a program of planned machine replacement. Within the last year alone we've purchased six new REEDS in 4-, 8-, and 12-oz. capacities. These give us superior finished products, along with high production and low maintenance. Having watched these new REEDS perform for us, I don't see how any molder can satisfy customers today with outdated equipment."



This 10-cavity shot of ladies' shoe heels weighs 24 oz. in acetate. A 300TA—12/16 oz. REED equipped with the new Jumbo cylinder handles this job on a 65-second cycle.



Missouri Valley Plastics Co., Inc., Kansas City, Mo., uses a 175T—4/6 oz. REED, with built-in stuffing arrangement and Jumbo cylinder, to mold these auto washing brush parts. The 6½ oz., 4-cavity shot is high-impact styrene.

REED-PRENTICE

Affiliate of **PACKAGE** MACHINERY COMPANY

677 CAMBRIDGE STREET, WORCESTER 4, MASS.

BRANCH OFFICES: NEW YORK • CLEVELAND • CHICAGO • BUFFALO • DAYTON • DEARBORN • KANSAS CITY • LOS ANGELES

"We get the most consistent with Pittsburgh Fiber Glass

. . . says Mr. Forrest Engelhart, President, Automatic Plastic Molding Company, Berkeley, California

"Plastic products reinforced with fiber glass account for 50% of our business," reports Mr. Engelhart. "Our major product is safety helmets, but we also produce file drawers, film developer trays, kindergarten chairs and battery cases.

"Here's how our production improved when we switched to Pittsburgh Fiber Glass Roving as a reinforcing agent:

1. IMPROVEMENT OVER FORMERLY USED MATERIAL

"The reinforcing material we previously used was not Fiber Glass and could not pass the water absorption test, would deteriorate with age and weather, and we could get only one color with it. Pittsburgh Fiber Glass Roving eliminated these inadequacies.

2. UNIFORMITY CUTS REJECTS

"We used Pittsburgh Type 500 and Type 508 Fiber Glass Roving with chrome finish. We must obtain a critical mixture to assure product strength. We find Pittsburgh Roving to be the most consistent in uniformity, and rejects have been reduced to less than 2%.

3. HELMETS MEET NAVY SPECIFICATIONS

"As a result of this consistent uniformity and the superiority of fiber glass roving characteristics, our safety helmets meet the Navy's strict specifications. These include passing a 40 foot-pound impact test, water absorption test, dielectric test and penetration test."

PITTSBURGH ROVING CAN HELP YOU, TOO

If you haven't used Pittsburgh Fiber Glass Roving in your molding or laminating operations, give it a try. We will be glad to arrange tests right in your plant by our technical staff. Contact our executive offices or one of the district sales offices listed below. *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

Screen with three helmet forms is removed from pre-form machine. Two-inch Pittsburgh Fiber Glass Roving is forced on screens by suction. About 800 pre-forms are produced per man each 8-hour day.

Liquid resin is poured over pre-form. Helmets contain 50% resin, 50% fiber glass. Molding period for these helmets takes two and one-half minutes.

Helmets are weighed and inspected before shipping. Weight specifications must be within one ounce tolerance. Helmets meet strict Navy specifications, thanks to Pittsburgh Fiber Glass Roving.

PITTSBURGH FIBER GLASS ROVING IS A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh and St. Louis

FIBER PG GLASS

PAINTS · GLASS · CHEMICALS · BRUSHES · PLASTICS

PITTSBURGH PLATE GLASS COMPANY

quality Roving"

Automatic Plastic President Forrest Engelhart displays finished helmet. Pittsburgh Roving's uniformity has reduced rejects to below 2%.

Can it be sleeping that's making you tired?

... Time to wake up and let PEERLESS show you what's new in Plastics Marking.

We at PEERLESS have developed a roll leaf that resists wear ... oil and alcohol stain ... perspiration ... and most every type of punishment possible.

PEERLESS Roll Leaf Company has marked practically every type of plastic ... has made equipment for marking most every size and shape of plastic product ... and continues to be first in their field with new advancements in plastics marking, and the manufacture of plastics marking machinery.

Come on now, sleeping is all right at home, but not during a working day ... wake up ... call or write PEERLESS ... let us tell you "what's new".

Achievement toward Perfection

PEERLESS ROLL LEAF COMPANY, INC.

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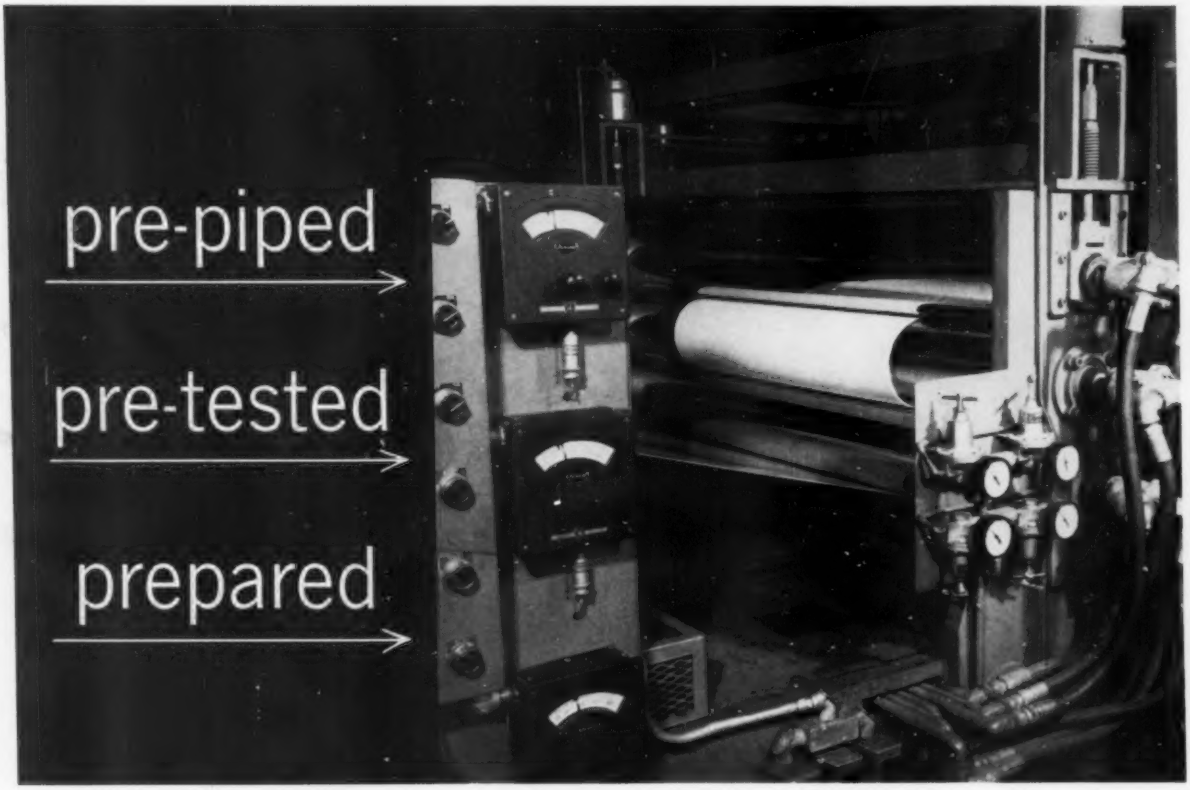
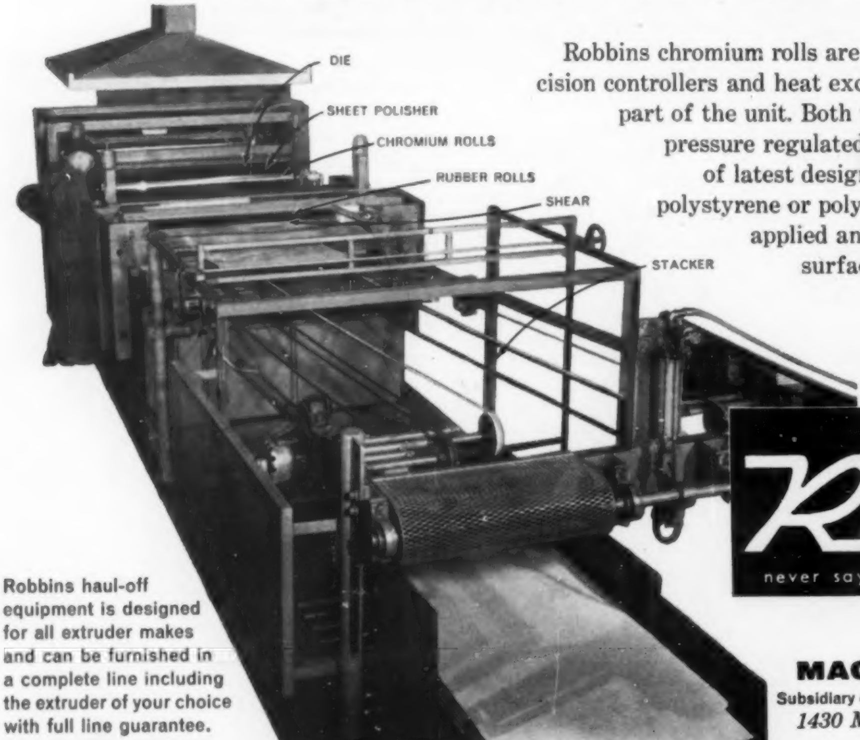
BRANCH OFFICES: BOSTON • CHICAGO • *Peerless Roll Leaf Division* • GANE BROS. & LANE, INC.
REPRESENTATIVES: ST. LOUIS • LOS ANGELES • SAN FRANCISCO • LOUISVILLE • MONTREAL • LONDON, ENG.



Robbins Chromium Roll Sheet Haul-Off Unit is completely pre-piped with temperature controllers, heat exchangers, pumps and all electrical work finished and ready.



Robbins chromium rolls are heated and cooled. Precision controllers and heat exchangers are an integral part of the unit. Both top and bottom rolls are pressure regulated with automatic devices of latest design. Decorative overlay of polystyrene or polyester films can be easily applied and calendered. Embossed surfaces can be produced too.

Please write

Robbins

never say die . . . say Robbins die

PLASTIC MACHINERY CORP.

Subsidiary of Lynch Corp., Anderson, Ind., U.S.A.

1430 Mishawaka St., Elkhart, Ind.

Robbins haul-off equipment is designed for all extruder makes and can be furnished in a complete line including the extruder of your choice with full line guarantee.

from die to sheet stacker **ROBBINS** engineered and **ROBBINS** built

hi-fax® .. the high-density

Looking at high-density polyethylenes for improved products and lower costs? Then be sure to check Hi-fax.

Here's why Hi-fax is different:

Hi-fax, as produced by Hercules' exclusive process is different in nature and performance from all other high-density polyethylenes. It is formulated at a density which provides optimum performance in terms of the key properties you need.

Different because: Temperature Resistance

From boiling water to sub-zero temperatures, Hi-fax retains its dimensional stability, flexibility, and impact strength. Non-toxic, too, it's the ideal plastic for housewares, containers, toys, and food packaging.

Different because: Lightweight

Providing rigid strength in thin-wall sections, Hi-fax, lightest of all high-density polyethylenes, yields extremely lightweight, highly functional structures.

Different because: Rigidity

The stiffness of Hi-fax permits the design of thinner wall structures, substantially reducing material costs without sacrificing appearance or function in the end product.

Different because: Toughness

Unbreakable and abrasion-resistant, Hi-fax provides a sturdy, low-cost plastic for heavy-duty industrial applications, mechanical uses, pipe, wire and cable, film and paper coatings.

Different because: Stress-Crack Resistance

No other high-density polyethylene can match the stress-crack resistance of Hi-fax. This key property makes Hi-fax the preferred polyolefin in detergent packaging, wire and cable coatings, and any other uses where resistance to embrittlement due to atmospheric or chemical exposures is important.

HERCULES

THREE NEW MATERIALS FOR THE PLASTICS INDUSTRY

Hi-fax High-density polyethylene • Pro-fax* Polypropylene

Penton® Chlorinated polyether

**Hercules trademark*

polyethylene that's different

Need a custom-built high density polyethylene exactly tailored to your market?

Only Hi-fax gives you a choice of 7 end-use types.

1. Injection Molding

A broad selection of injection molding types offering the optimum in physical properties, moldability, color and finish in four different melt index ranges.

Royal thermos jug has base, cap and handle molded with Hi-fax by Avsco Inc., Excelsior Springs, Missouri.

2. Blown Containers

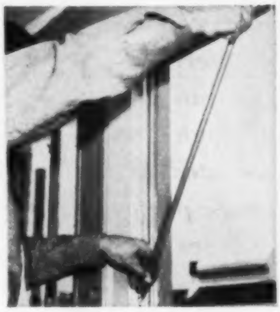
The only high-density polyethylene especially formulated for blow molding. Produces lightweight, thin-wall containers with outstanding heat, chemical, and stress-crack resistance.

Another first for Hi-fax! Thermoplastic syrup jar at left molded by Royal Manufacturing Co., Prescott, Arizona, for Maynard Manufacturing Co., Glendale, California.

3. Pipe

An exclusive Hercules formulation, based on more than three years of laboratory and field testing, designed to yield better plastic pipe at lower cost.

Hi-fax can be fabricated in conventional equipment, yields uniform wall thicknesses even in large diameter pipe.



4. Extrusion

Your choice of four extrusion grades specifically formulated to provide the combination of physical and mechanical properties required in your process and products.

By using Hi-fax tubing in its sash balance assembly, Unique Balance Company makes an already fine product an even better one.

5. Wire and Cable

Three special grades providing outstanding abrasion and stress-crack resistance, the two properties most important to the electrical industry.

Hi-fax produces low-cost plastic-coated tree wire capable of withstanding rugged, long-term exposures to abrasion and weathering.

6. Film and Paper Coating

Special grades with excellent workability, acceptable for direct contact with foods, and yielding low-cost films and paper coatings.

7. Monofilament

Resins which yield rope, cordage and fabrics with excellent "hand" and "feel", high tensile strength, abrasion resistance, flexibility and washability.

Cellulose Products Department

HERCULES POWDER COMPANY

INCORPORATED

900 Market Street, Wilmington 99, Delaware

CP58-3

Looking for more "shots per dollar" in vacuum metallizing coils?

By switching to the best coil design, vacuum metallizers have realized as much as 30% more shots per dollar from Sylvania Tungsten Coils. Why is this possible? Because Sylvania helps vacuum metallizers find the right coil to do their job most economically. Whether you buy ready-made coils or form your own from tungsten strand, Sylvania is ready to help you get maximum efficiency.

If your metallizing process calls for a custom-made coil, Sylvania can recommend the best design consistent with the equipment you're using and the metallizing job to be done. In many cases, metallizers can get top efficiency from an existing Sylvania design, many of which have already become so popular they are considered standard.

Sylvania coils are formed of high-density tungsten strand manufactured to exacting standards of quality control. Sylvania Tungsten Strand is available in 3 to 7 ply with wire diameters of 0.020 to 0.600 inches per strand.

We invite you to write, outlining your specific requirements and problems. You'll find Sylvania is your best source for vacuum metallizing coils designed and built to offer "more shots per dollar."

Sylvania Electric Products Inc.
Chemical and Metallurgical Division
Towanda, Pennsylvania

TUNGSTEN • MOLYBDENUM • CHEMICALS • PHOSPHORS • SEMICONDUCTORS

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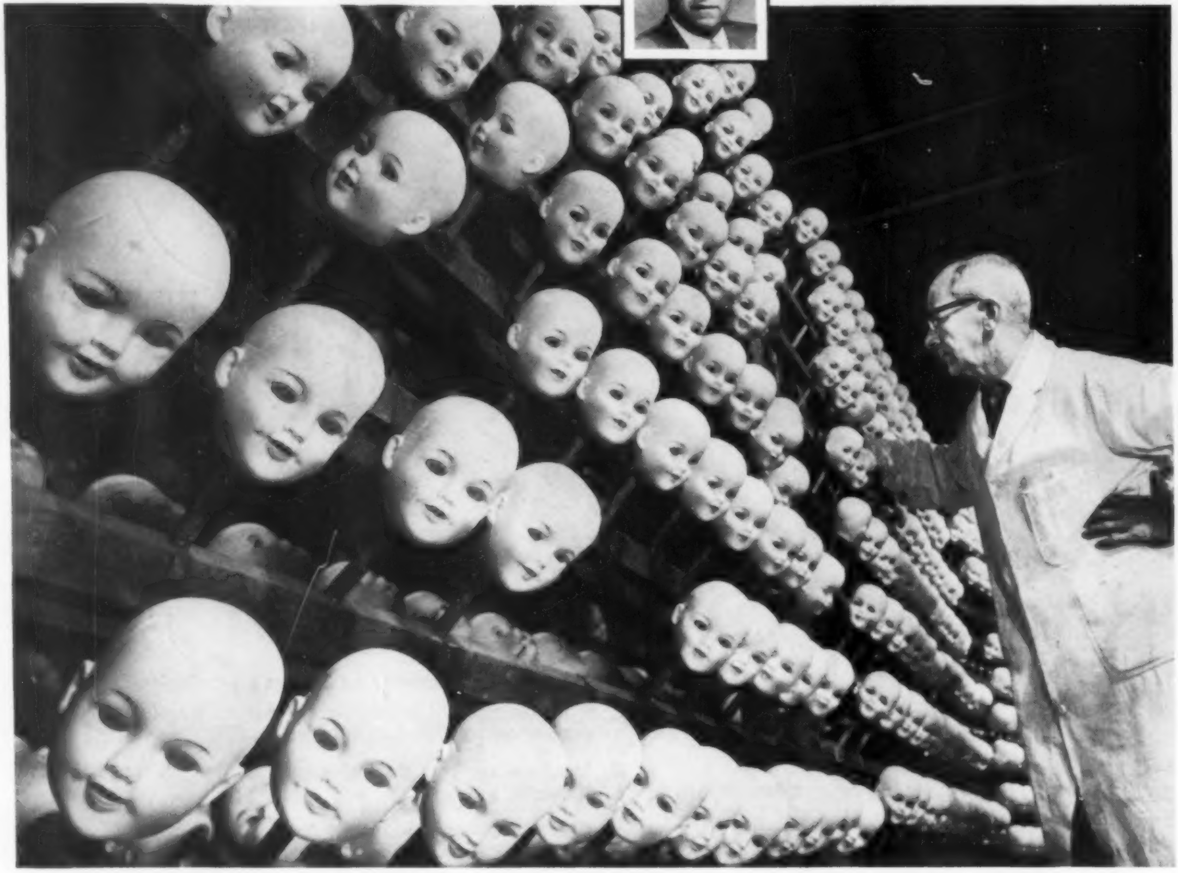
Lighting • Radio • Electronics • Television • Atomic Energy

"EXON 654 HELPS OUR ENGINEERS MAKE THE SHIRLEY TEMPLE DOLL A BEST-SELLER."

A. M. Katz, General Manager and Treasurer, Ideal Toy Corp.



Exon 654 gives this leading toy manufacturer warm, pliable "flesh" for his best-selling number.

Firestone EXON RESINS

Pliability is only one of the advantages Firestone Exon 654 Resin gives this best-selling doll. This resin also adds life-like warmth and longevity. And, most important to production men, it eliminates time-consuming operations which other materials require.

For instance, because the dolls are made by rotational molding with Exon 654, you mold units in one piece. No more cementing parts together. You can mix pigment right into the plastisol. No more dipping to color the dolls' "flesh."

No wonder Ideal Toy Corporation prefers dolls made of Firestone Exon 654.

This plastisol resin is part of industry's most complete line of versatile vinyls. Whether your problem is trouble-free, low-cost production or special corrosion applications, there's a Firestone Exon resin pin-pointed to your particular product, or production needs.

Industry looks to Firestone for engineered answers to its needs. For a resin with properties pin-pointed to the best answer for you, check with Firestone.

For complete information and technical service, call or write:

CHEMICAL SALES DIVISION: FIRESTONE PLASTICS COMPANY

DEPT. 82G, POTTSTOWN, PA. • A DIVISION OF THE FIRESTONE TIRE & RUBBER CO.

IN CANADA: CONTACT CHEMICAL SALES DIVISION, FIRESTONE TIRE AND RUBBER COMPANY OF CANADA, LTD., HAMILTON, ONT.

INDUSTRY'S MOST COMPLETE LINE OF VINYLS ENGINEERED TO YOUR SPECIFIC NEEDS

NEW IDEA LAB

FOR RUBBER & PLASTIC

• This Process Laboratory in Akron, Ohio is a birthplace of new ideas in rubber and plastic. Here we develop basic machines, such as automatically operated mills and processing screw extruders to:

1. **Produce more products per man-hour.**
2. **Produce products of higher quality.**
3. **Produce products with new and different material formulations.**
4. **Produce new end products.**

New materials, new processes and new products require new machines and new thinking. Wherever your horizons lead you, this Laboratory could possibly supply some of the answers. Your new idea or idea yet to be born can mature here. Outline your thinking by phone or letter and we will go to work.

AETNA · STANDARD

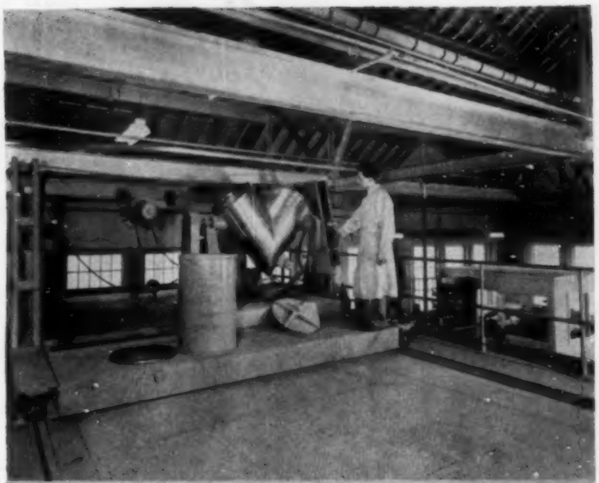
ENGINEERING COMPANY

PITTSBURGH, PENNSYLVANIA

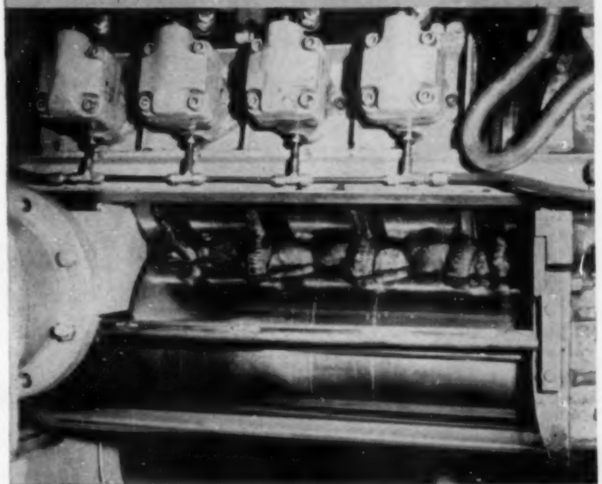
Sales and Engineering

HALE & KULLGREN, INC.

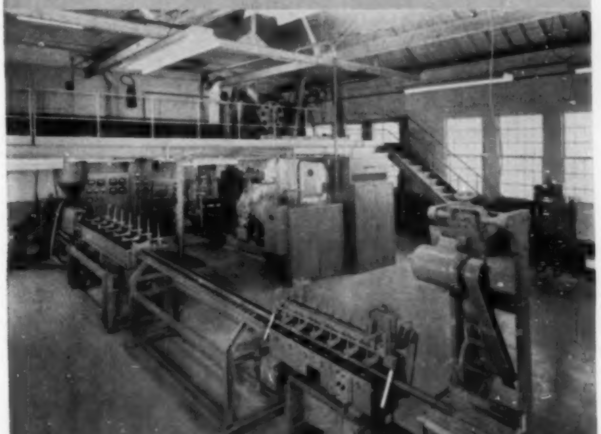
Akron, Ohio



Raw material handling may include blending, automatic weighing, and controlled feeding.



The Continuous Automatic Mill dispenses pigments and plasticizes uniformly without manual attention.



We specialize in screw machines for processing, blending, reclaiming, or devolatilizing.

✓ CHECK THESE FEATURES

of the Improved Model 75—4 ounce

MOSLO PLASTIC INJECTION MOLDING MACHINE

In order to meet the needs of plastic molders, Moslo engineers have incorporated many improvements in their line of plastic injection molding machines. These refinements provide even more efficient, trouble-free operation with a greater profitable return to molders. At right are listed a few of these improvements:

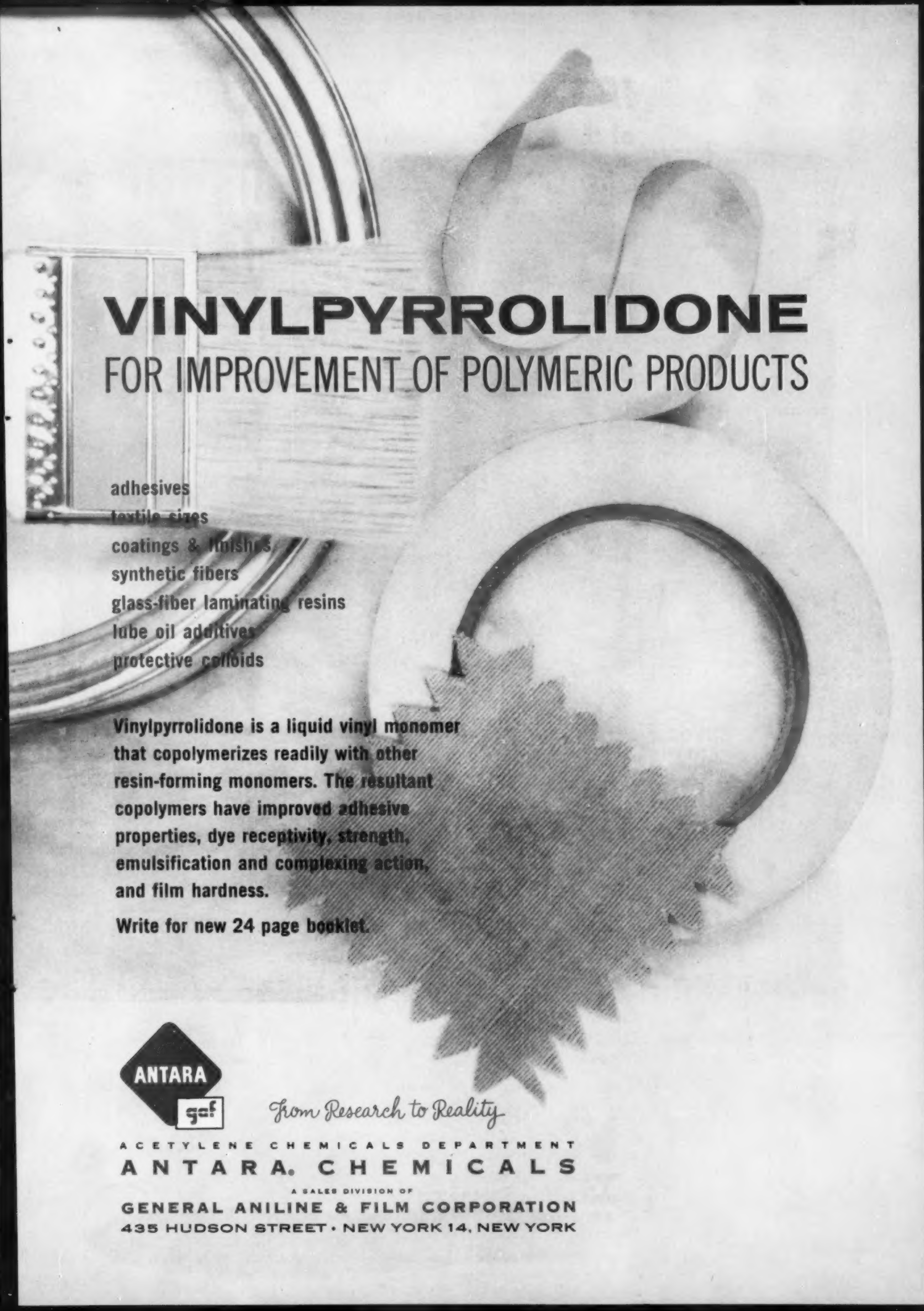
- All machine limit switches are **PLUG-IN** type. These switches plug in as easy as a radio tube; can be replaced in 20 seconds; eliminating hours of costly down time.
- Press control operation is timed by Microflex timers located in electrical control cabinet (not illustrated above). These timers with **PLUG-IN** features and Micrometer type dial assure dependability and accuracy.
- **PLUG-IN** heat pyrometers are standard equipment.
- New modified J.I.C. control circuits arranged for 115 volt, 60 cycle control makes possible greater safety and standardization for easy maintenance.
- Additional valving on manifold for injection unit increases overall machine efficiency.
- Improved self-compensating feed mechanism.
- Nylon tubing assures long life for automatic lubrication system. In addition, protective features greatly reduce possibility of contamination of finished part.
- Refinements on clamp linkage improve operation.

These are only a few of the improvements built into the Moslo Model 75, 4-ounce Machine. Write for complete details or we will be glad to have a sales representative call at your request.

MOSLO

MACHINERY COMPANY

2442 PROSPECT AVE. • CLEVELAND 15, OHIO


VINYLPYRROLIDONE
FOR IMPROVEMENT OF POLYMERIC PRODUCTS
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coatings & finishes
synthetic fibers
glass-fiber laminating resins
lube oil additives
protective colloids
Vinylpyrrolidone is a liquid vinyl monomer that copolymerizes readily with other resin-forming monomers. The resultant copolymers have improved adhesive properties, dye receptivity, strength, emulsification and complexing action, and film hardness.
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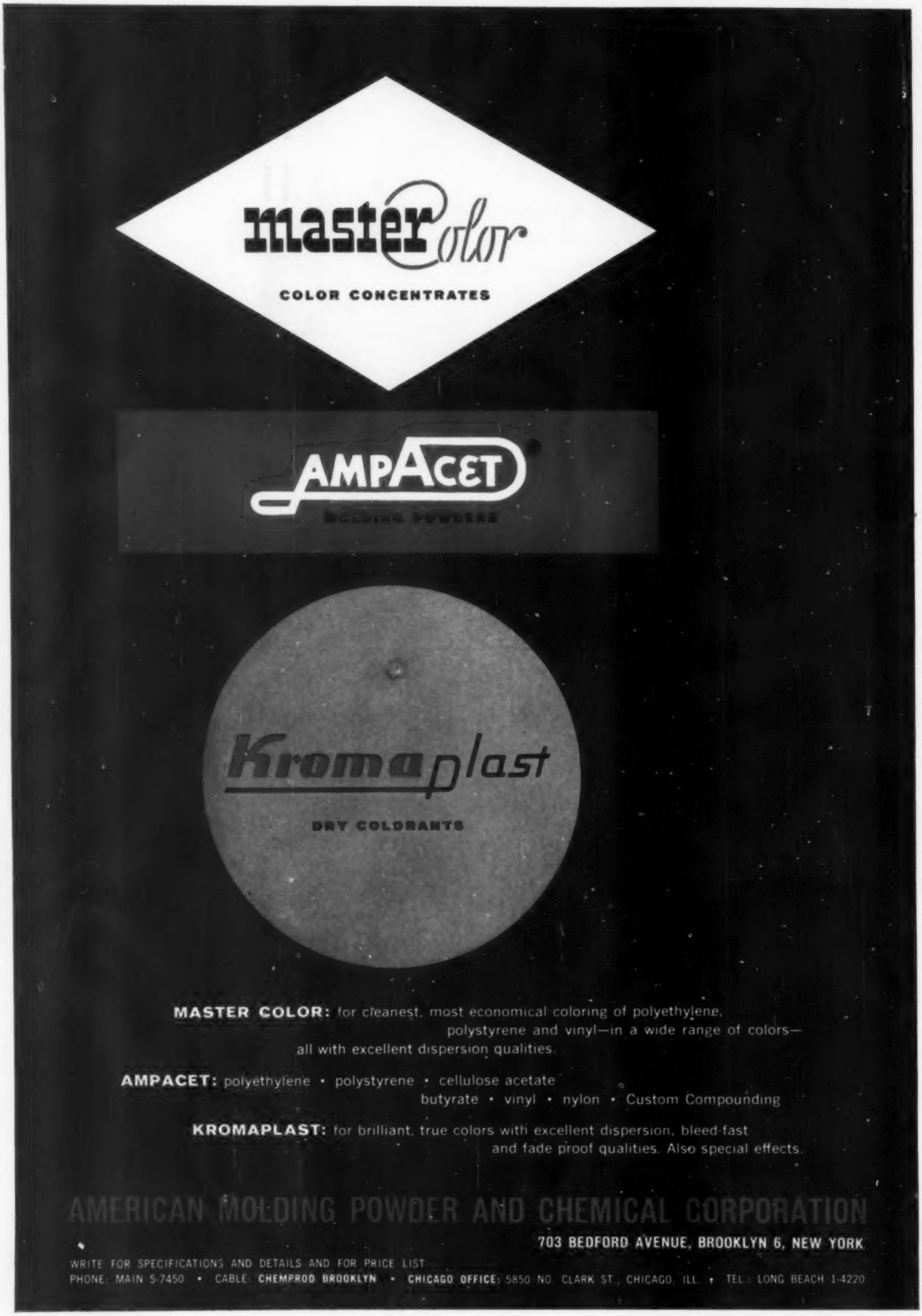
masterColor
COLOR CONCENTRATES
AMPACET
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DRY COLORANTS
MASTER COLOR: for cleanest, most economical coloring of polyethylene, polystyrene and vinyl—in a wide range of colors—all with excellent dispersion qualities.
AMPACET: polyethylene • polystyrene • cellulose acetate butyrate • vinyl • nylon • Custom Compounding
KROMAPLAST: for brilliant, true colors with excellent dispersion, bleed-fast and fade proof qualities. Also special effects.
AMERICAN MOLDING POWDER AND CHEMICAL CORPORATION
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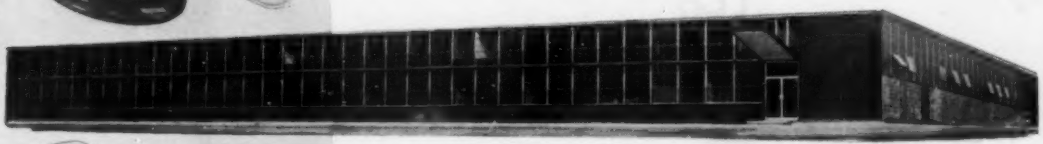
PHONE: MAIN 5-7450 • CABLE: CHEMPROD BROOKLYN • CHICAGO OFFICE: 5850 NO. CLARK ST., CHICAGO, ILL. • TEL.: LONG BEACH 1-4220

INJECTION MOLDING BY
CONSOLIDATED



Scranton, Pennsylvania:

The caption takes on added meaning with the opening of our fine new plant, exclusively devoted to injection molding. Located in Lackawanna Valley's Industrial Park, it contains 80,000 square feet of space on one floor and houses 23 injection presses plus unexcelled spray painting, metallizing, and other decorating and finishing facilities. There will be no better injection plant in the East—and no more experienced or knowledgeable production staff.

Binghamton, New York:

New York State manufacturers now enjoy the added convenience of this new addition to our injection molding facilities. Twenty thousand square feet of floor space, seven modern injection presses, new dimensions in decorating and finishing—all these and a sound organization, too, are right on the spot to serve you better.

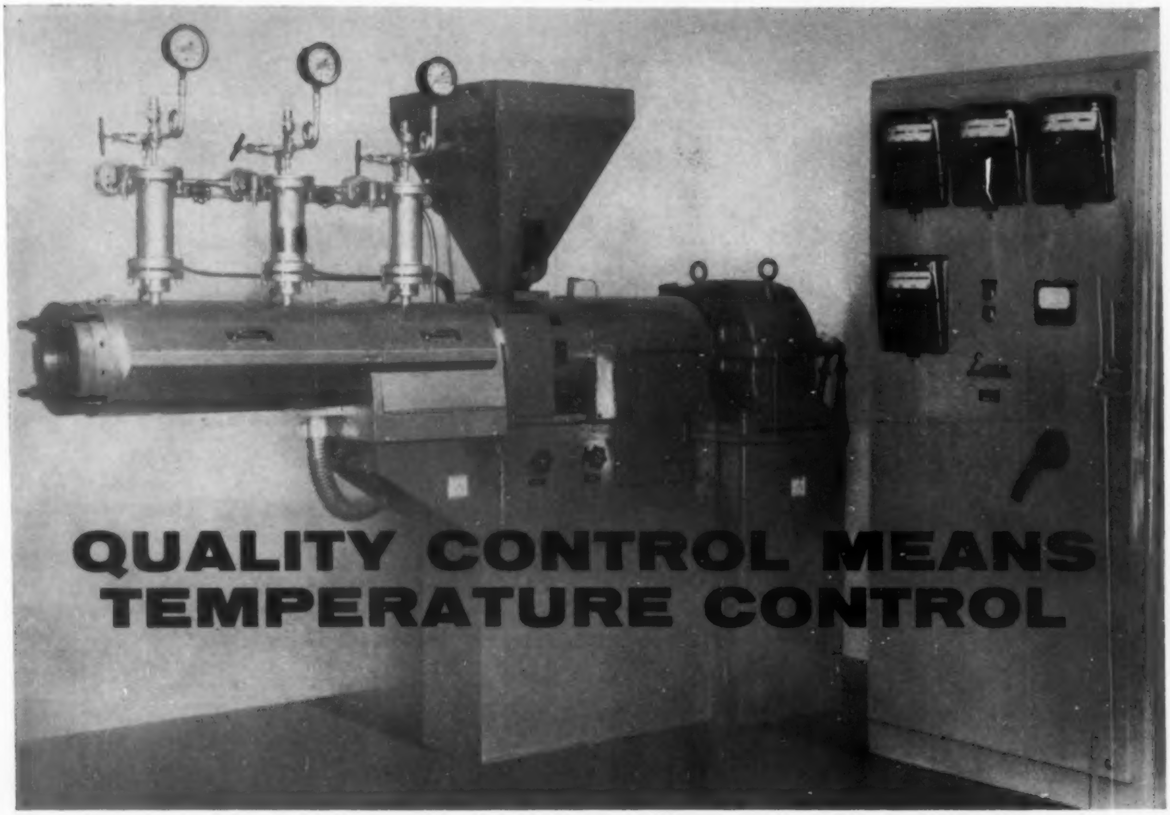
Whatever your injection molding need, Consolidated has the wherewithal to serve you to your complete satisfaction. Two new plants in operation have equipped us better than ever before to handle any injection molding job. Why don't you see for yourself what our expansion—backed by long experience—can mean to you?

"Your Blueprint in Plastics Since 1874"

At Consolidated, Everything is Modern Except Our Old-Fashioned Pride in Craftsmanship

CONSOLIDATED MOLDED PRODUCTS CORPORATION

Scranton, Pa. and Binghamton, N.Y.



Egan Extruder With "Willert Temperature Control System" Automatically Eliminates Temperature Variations

Heating the plastic material in the extruder cylinder, whether by conduction, induction, or friction, is no problem — assuming the designer has provided sufficient heating capacity and a properly designed screw.

However, provision for efficient dissipation of excessive heat is essential to make any temperature control system complete.

The Willert System is the ultimate in complete control! Excessive heat is removed automatically without moving parts, and without any manual operation of valves or switches by the operator. As a result, closer tolerance extrusions are produced easier and faster.

The Egan Extruder shown above, complete with "Willert Temperature Control System," is available in sizes from 2" through 10". It incorporates standard Egan features such as: herringbone gears, separate heavy duty thrust bearing assembly, complete control panel, wiring, piping, hinged covers for easy access to thermocouples, hopper, screw speed tachometer, and ammeter. Additional features are available.

Write, or Phone Randolph 2-0200,
For Complete Information — No Obligation.

Egan **FRANK W. EGAN & COMPANY**

SOMERVILLE, NEW JERSEY
CABLE ADDRESS: EGANCO — SOMERVILLE (NJER)

Manufacturers of plastics extruders, dies, take-offs, and other accessories

REPRESENTATIVES: MEXICO, D. F.-M. H. GOTTFRIED, AVENIDA 16 DE SEPTIEMBRE, JAPAN-CHUGAI BOYEKI CO., TOKYO.
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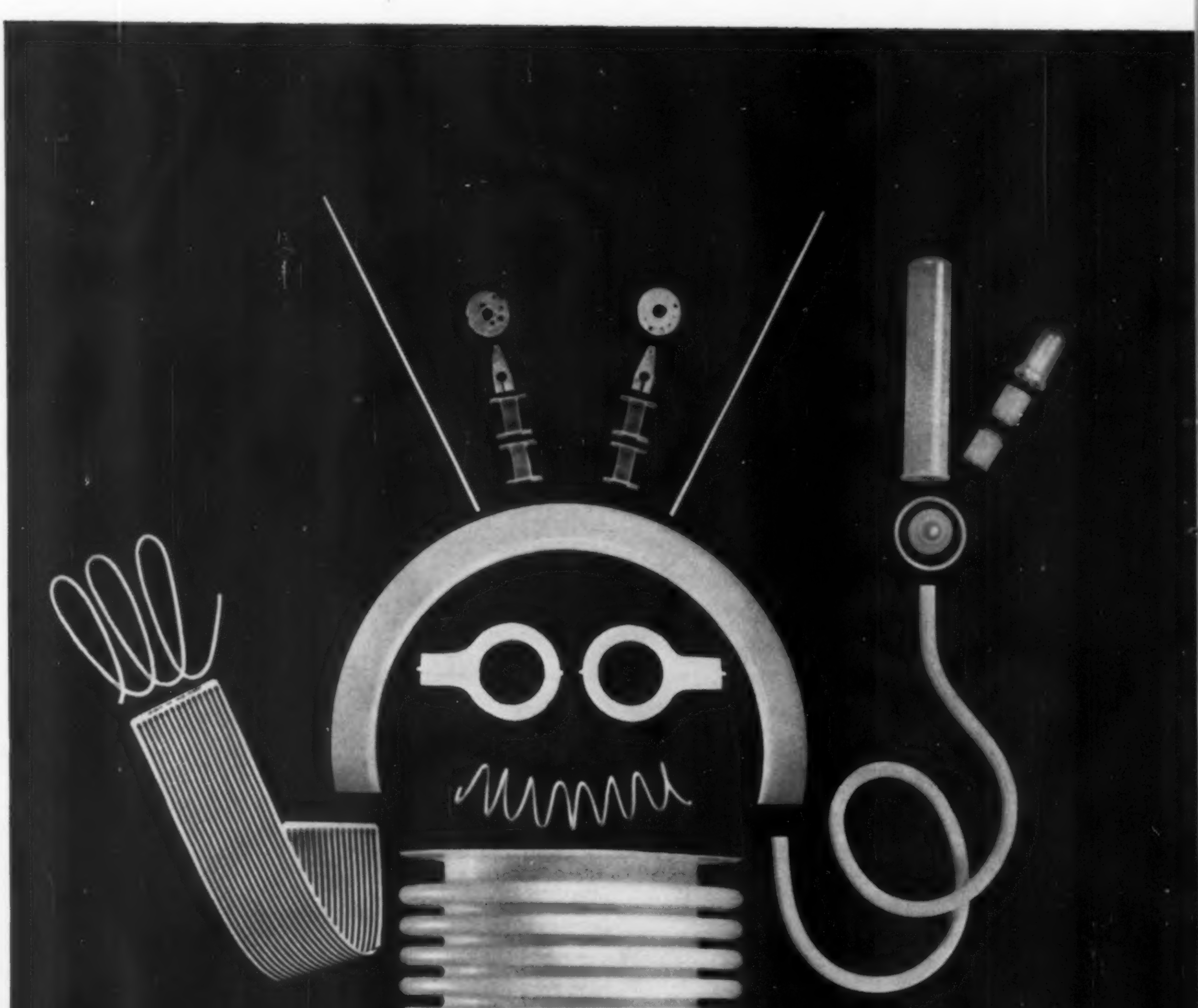

3M Chemicals opening new worlds of use for plastics

INSULATES electrical components despite moisture, violent chemicals, temperature extremes!

KEL-F® PLASTIC

3M CHLOROTRIFLUOROETHYLENE POLYMER

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KEL-F polymer has the high dielectrical strength that provides superior insulation at all frequencies (volume resistivity -1.2×10^{18} ohm-cm at 50% relative humidity and 25° C.). Not only that! As shown below, this 3M chemical product exhibits remarkable chemical and thermal stability—amazing resistance to corrosive chemicals, humidity, abrasion and temperature extremes.

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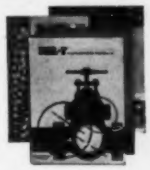
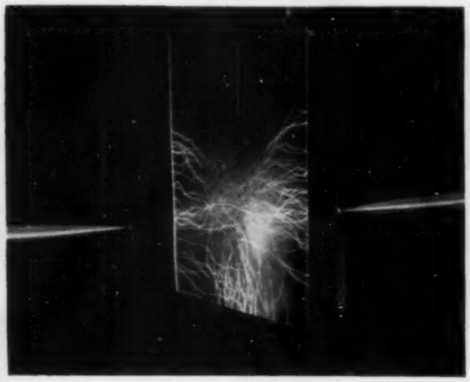
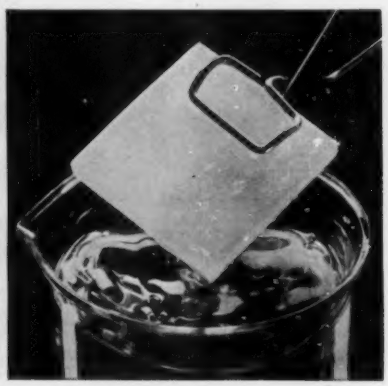
The entire line of KEL-F halofluorocarbons—molding resins, dispersions, elastomers, laminates, waxes, greases and chemicals—exhibits properties that increase efficiency and economy in electrical and many other operations. Investigate KEL-F polymer—write for free literature giving complete data: Chemical Products Group, 3M Company, Dept. WU48, St. Paul 6, Minnesota.







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HIGH DIELECTRIC STRENGTH: Short time 1/16"—530 v/mil. Extremely high-volume resistivity: 1.2 x 10 to the 18th power (1.2×10^{18}) ohm-cm at 50% relative humidity and 25° C. Arc resistance: > 360 sec. Superior insulation at all frequencies.

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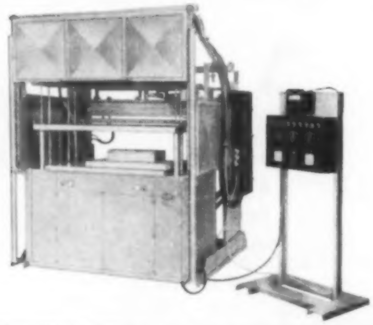

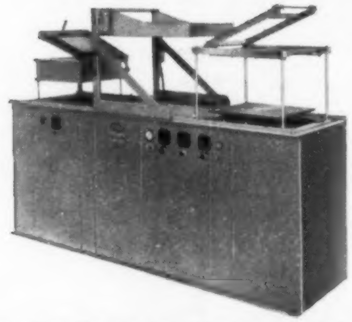

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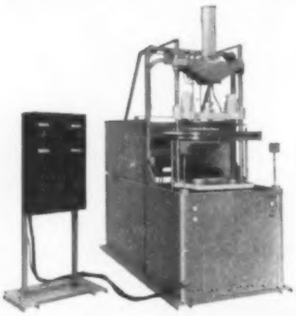

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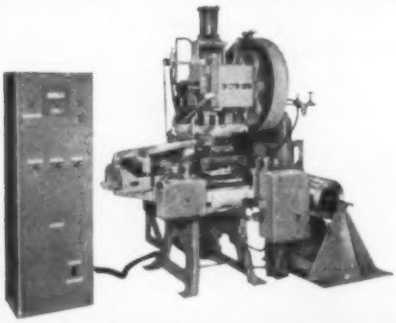

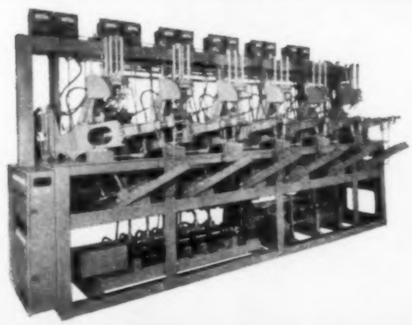

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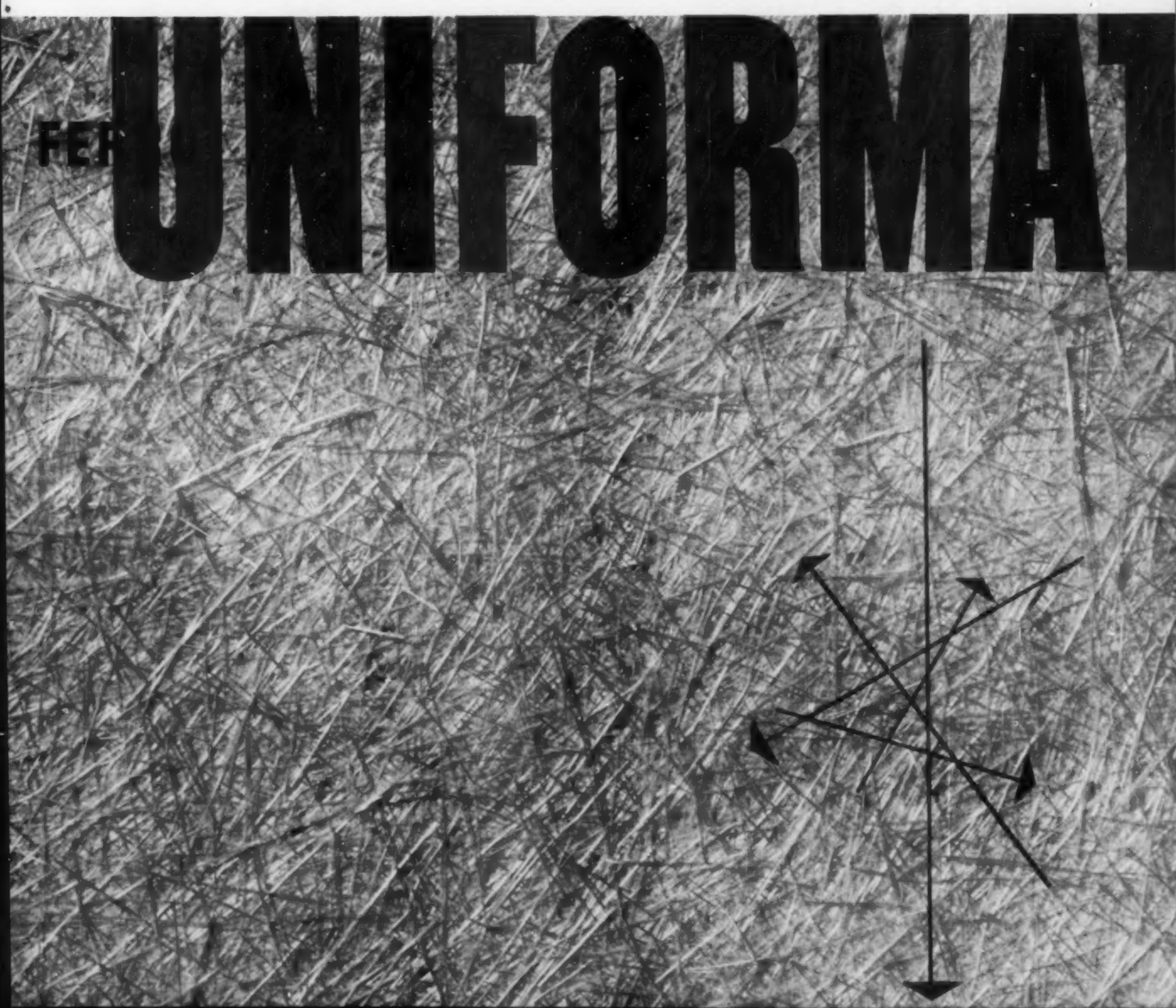

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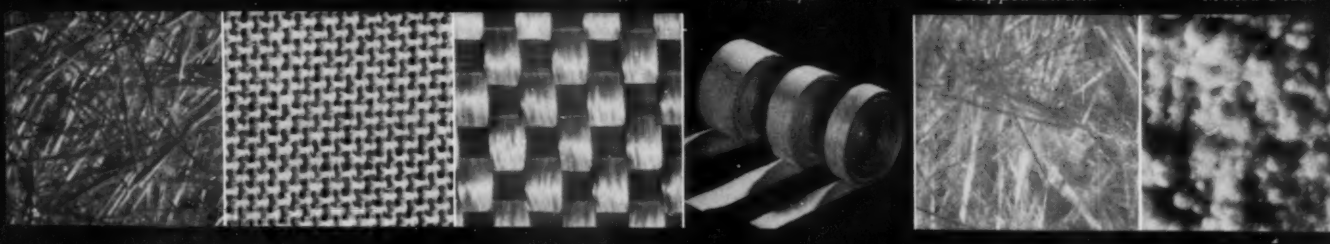

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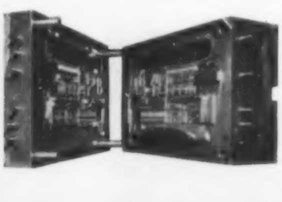

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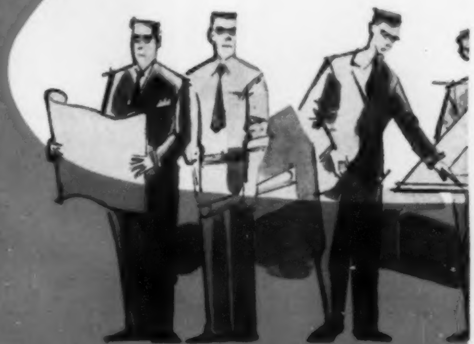

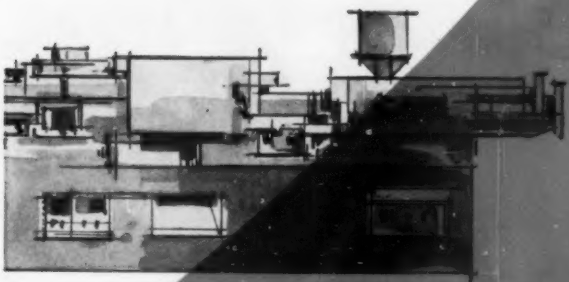

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A partial listing

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Yellow Oxides
Green Gold
Chlorpara Red
Toluidine Red
Naphthol Reds
Alizarine Reds
Chlornaphthol Reds
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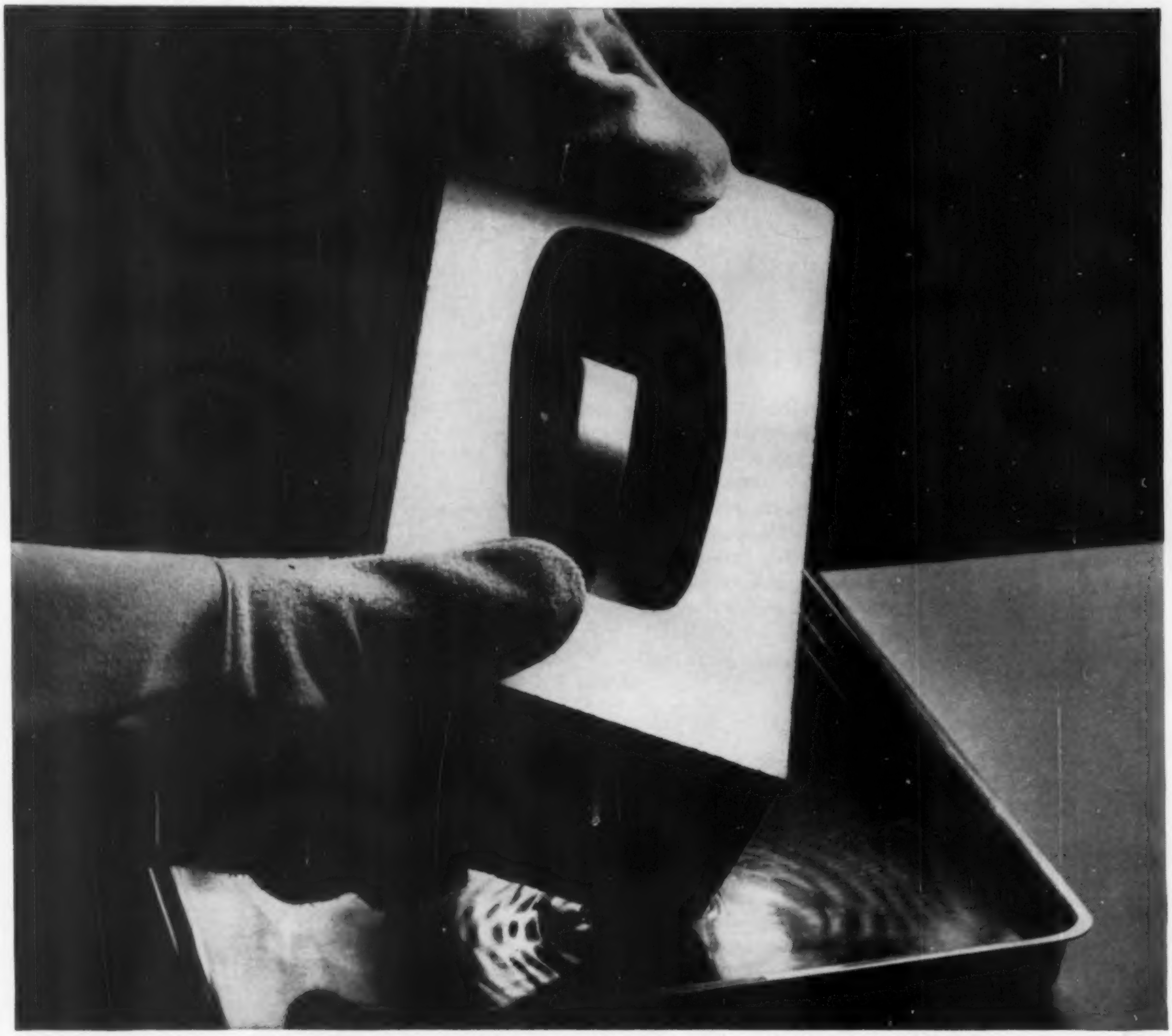

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NEW compound cuts die costs 50% to 90%

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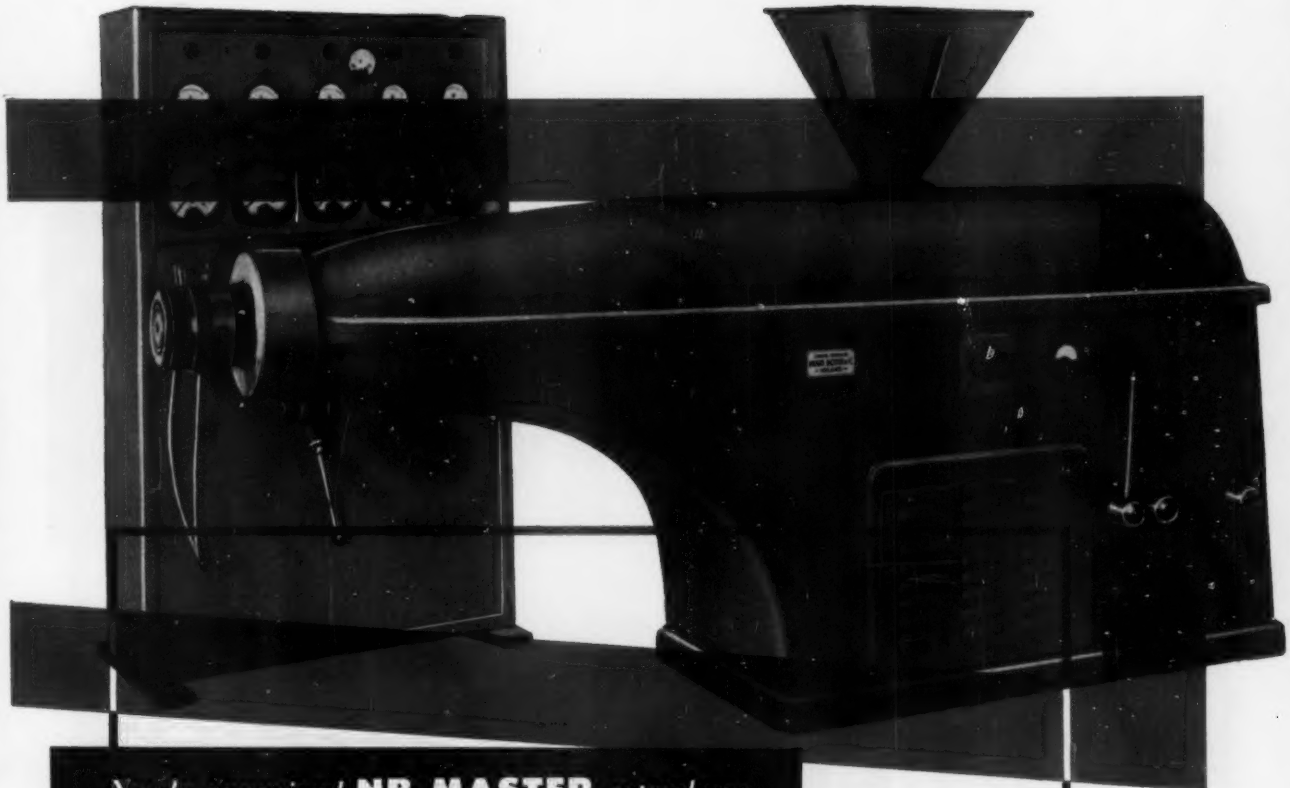

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- ▷ **easiness in screw extraction for interchanging operation or cleaning of cylinder**
- ▷ **special designed rapid fastening method for quick assembling of heads**

model	screw Ø
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NB 45 MASTER	mm 45
NB 60 MASTER	mm 60
NB 70 MASTER	mm 70
NB 90 MASTER	mm 90

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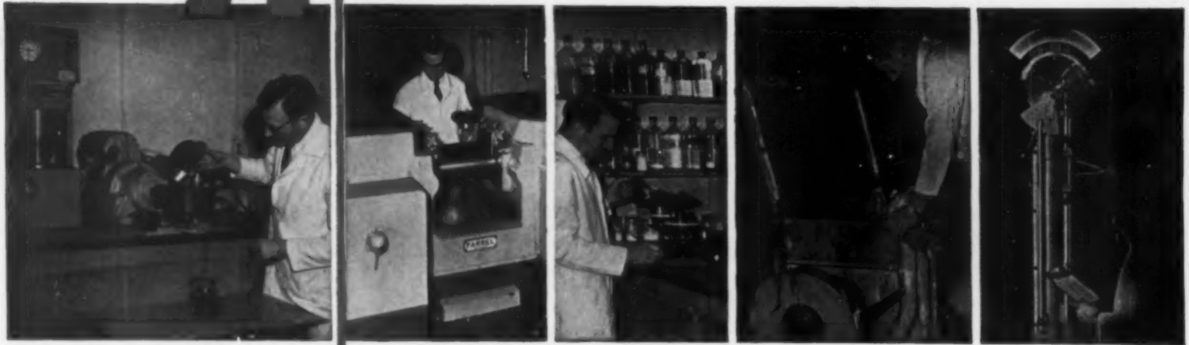

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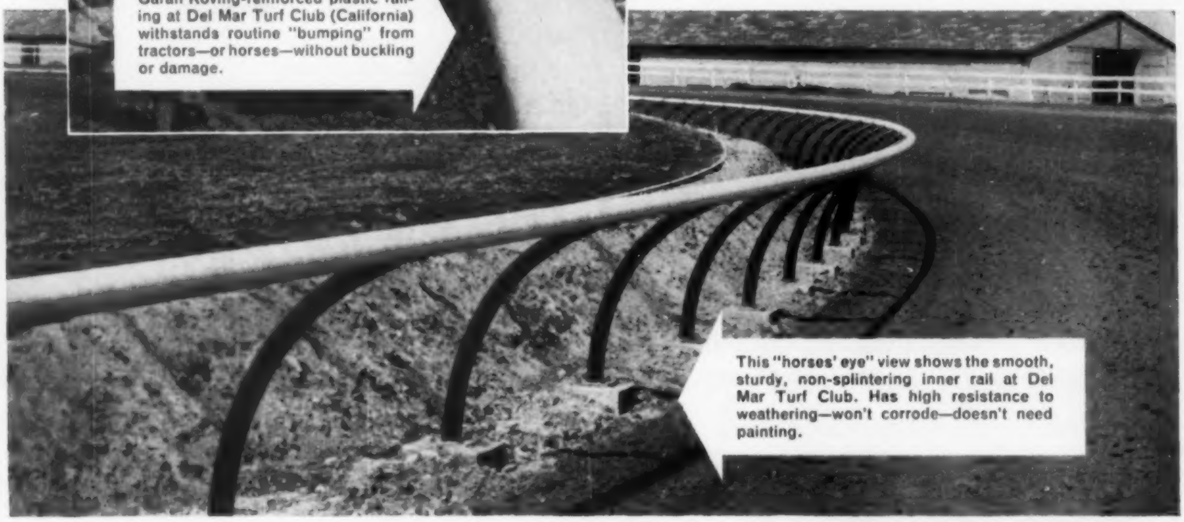

This "horses' eye" view shows the smooth, sturdy, non-splintering inner rail at Del Mar Turf Club. Has high resistance to weathering—won't corrode—doesn't need painting.

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Don't miss . . . in this issue

A picture of tomorrow's plastics packages. Our lead feature, tieing-in with Weimer Purcell's cover illustration, presents significant trends. New materials and forms of materials, new package constructions, new design concepts, and new processing methods are due to increase the use of plastics by the packaging market. A chart of plastics package production methods is offered on p. 97 for quick comparison by readers, and on p. 98 five package designers give their views on this challenging subject. See "Tomorrow's plastics packages," p. 95.

New method of document lamination. With transparent acetate sheet to which has been applied a pressure-sensitive adhesive protected by peel-off paper, anybody now can laminate photographs, licenses, cards, letters, and other documents at low cost and in minutes. At least four such products are now on the market and others are appearing in rapid succession. Looks like a big thing for do-it-yourselfers. See "Press-less laminating," p. 104.

The first story on slush molding polyethylene. Quite intricate and interesting products can be made with specially designed equipment and balanced blends of low-molecular and high-molecular-weight polyethylenes. The difference between this technique and that used for slush molding vinyl plastisols is that with polyethylene the shot goes into a cold mold while with vinyl the molds are heated. Here's the complete dope on this development to date. See "How to slush mold polyethylene," p. 112.

A better way to make high-density polyethylene blown tubing. Blow-extruded tubing of high-density polyethylene can be thermoformed into a wide variety of packaging containers, but production of such tubing requires close attention to various operating conditions. Here are recommendations for the production and forming of high-quality products. See "Extrusion and forming of high-density polyethylene blown tubing," p. 137.

A new job for the "work horse." General-purpose phenolic is rapidly moving into a new market—blower wheels for moving air. In room heaters, in air conditioning, in industrial processes these wheels—not to be confused with fans—are performing satisfactorily. It took months of engineering and special mold design to do it. See "Blower wheels—new field for phenolics," p. 118.

An improvement in flexible urethane foams. Such foams made with polyesters based on dimer acids have properties superior to those of foam rubber. Yet they are less costly than adipic-type polyesters and equivalent to the polyether and di-isocyanate systems. This article tells why the dimer acid polyesters may play a big part in the future of urethane foams. See "Polyesters of dimer acids as intermediates for urethane foams," p. 145.

An important new use for reinforced plastics. Underground transformer vaults, formerly most expensively built on-the-spot in concrete and steel, are now molded out of glass-polyester with great savings in construction cost and installation labor. The new product should make possible more wide-spread use of underground power cabling in residential developments and the consequent elimination of unsightly overhead wires. See "Where plastics compete with concrete," p. 102.

Know-how in machining TFE fluorocarbon resin. Since this material is relatively expensive, one big problem is to prevent waste. Machining to close tolerances with a minimum of waste requires some special tooling, training, machining techniques, and quality control procedures. See "Machining TFE resins," p. 123.

The possible market for wood-flour-filled urea. This material, never vigorously promoted in this country, is big business in England and elsewhere. Recent developments in compounding techniques have resulted in an improved product and it may be that it can be successfully marketed here. See "Why not wood-flour-filled urea?" p. 115.

Watch for . . . our June cover which will feature plastics in the furniture field; in an accompanying article will be discussed the increasing importance of all plastics to furniture . . . the June lead feature which concerns high heat-resistant plastics; these "exotic" materials, while still a mystery to many people, are of great importance to the missile program, to the computer field, to aircraft . . . an article on a new method of product marking for small appliance handles, electronic parts, radios, etc., with the use of printed anodized aluminum and new adhesives . . . automatic injection molding in a big captive plant . . . reinforced plastics turbo blades for jet engines . . . the economics of automatic thermoset molding and resin requirements for same . . . and always more information on what's new in plastics, plastics markets, processing methods, and profit possibilities.

MODERN PLASTICS
Volume 35
May 1958
Number 9

Tomorrow's plastics packages

Many different plastics in many different forms are invading the fabulous packaging market. Here is the outlook

What will tomorrow's plastics packages look like? Could they possibly be as fantastic as industry has been led to expect?

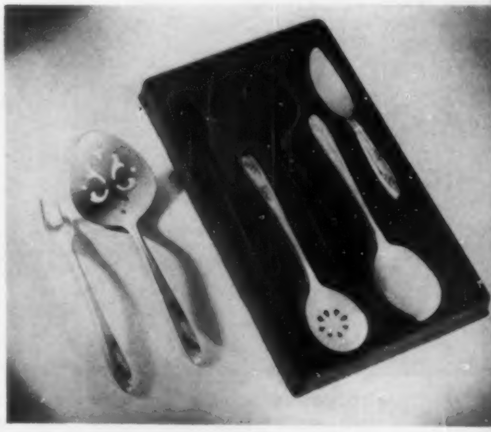
Comments by leading industrial designers on the future for plastics packaging (p. 98) would seem to indicate so—and it's only the beginning!

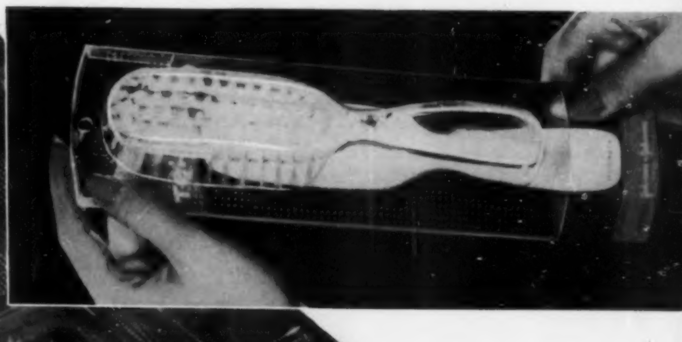
When one talks about packages, one is speaking of millions and even billions of units a year. Take only one single phase of plastics packaging—the polyethylene squeeze bottle—and consider its 8000-fold increase over the past six years (from 50,000 units in 1951 to about 400 million units in 1957) as well as its anticipated volume of 1½ billion units by 1960. Add to these zooming totals the figures given elsewhere in this article for other areas of plastics packaging and the result is impressive.

What form will the plastics packages of the

Thermoformed packages

Two new trends: continuous forming (left) of butyrate blister slide pack for hairbrush (below); at right, an adaptation of pre-flocked styrene sheet to silverware package. (Photos: left, Plaxall; below, Chicago Molded; right, Gilman Bros.)





Frozen pre-cooked foods in polyethylene-polyester laminate bag can be dropped into boiling water (bag and all) to be prepared for serving. (Photo, Du Pont)

Protective polyethylene envelope for steel stock can be easily peeled back when stock is to be used. (Photo, Crucible Steel)

future take and what materials will be involved? These projections are summarized in the table on p. 97.

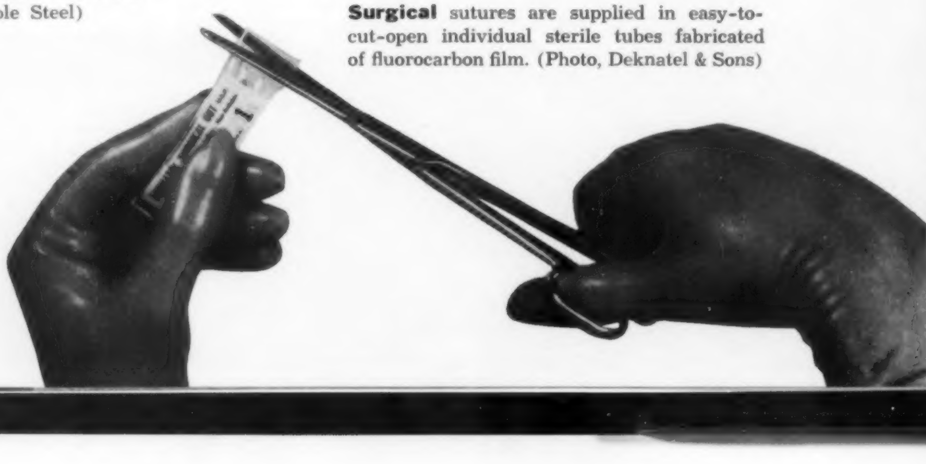
Thermoformed packages

It has been estimated that thermoformed packages of all types account for about 9 million lb. of plastic sheet annually, or about 10% of all the sheet plastic currently being thermoformed—and everyone still insists that there is much more to come. From tools, cutlery, and other hard goods, thermoformed packages have already moved into the food field and are now invading the soft goods area—handkerchiefs, socks, etc.

A good deal of the work in the field is aimed at achieving precise, high-speed, and automatic production. Even materials development, particularly in the laminates, points in the same direction. One such laminate, for example, developed by Print-a-Tube Co., Rochelle Park, N. J., is a combination of tough Mylar polyester film and heat sealable Alathon polyethylene, and is being used by G-E-M Products Co., Chicago, Ill., to skin pack a brake adjusting tool. Because of the unique properties of the film, an uncoated, perforated paperboard can be used as a backing for the product. The vacuum can easily be drawn directly through the porous board, pulling the film tightly down over the product. A single heat and vacuum cycle with this film averages only 10 sec., compared with the usual 40-sec. cycle on operations of this type—an operation that is looked on as an important step in the direction of automation. The packaging operation was performed by United States Packaging Co., Chicago, Ill.

Another interesting new thermoformed package is a unit pack for Easter egg vegetable dyes distributed by Fred Fear Easter Egg Color Co., Inc., Brooklyn, N. Y. The complete sales unit includes 16 individual sealed packets of the coloring material. The gang-formed packets consist of shallow cavities formed into a 3-mil

Surgical sutures are supplied in easy-to-cut-open individual sterile tubes fabricated of fluorocarbon film. (Photo, Deknatel & Sons)

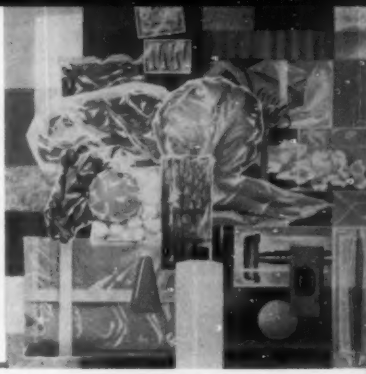


transparent vinyl film. The package is covered with a heat-sealed layer of vinyl film or, optionally, an adhesive-sealed layer of printed paperboard. The packages are formed, filled, and sealed in an integrated sequence at high-speed, using roll-fed stock, on automatic equipment developed by Cloud Machine Co., Chicago, Ill. The equipment can be set to produce perforations between adjacent packages for convenient separation.

Despite all this activity, however, the area of automatic production, filling, and sealing of thermoformed packages is still open for further development. Only last year, equipment was developed for forming, filling, and sealing blisters at rates up to 18,000 units per hour and indications are that this figure can be topped sometime this year.

Much activity has also been noted in the development of techniques for locking the plastic blister or contour enclosure to a card. One such

The selection of packaging as the subject for this month's cover story is particularly appropriate inasmuch as the AMA National Packaging Exposition will be held May 26-30 in New York. The accompanying article reviews some of the current and expected trends that will make plastics' role in the show more important than ever before.



Seven basic categories of plastics packaging

Method of fabrication	*Typical plastic materials used*	*Finished forms of package*	*Examples of products packaged*
I.—Thermoforming plastic sheet and film	Acetate, butyrate, impact styrene, ABS resins, polyethylene, vinyl, and other thermoplastics	Skin, bubble and contour packs, slide boxes, strip packages, containers with removable covers	Household and personal items, food products, small hardware and industrial parts, toys, drugs, and cosmetics
II.—Conversion of extruded or cast plastic films	Polyethylene, vinyl, acetate, saran, polyester, styrene, nylon, fluorocarbon and various combinations	Pouches, bags, wraps, "chub" packs, vacuum packs for sliced meats, etc., box and drum liners, tube-like dispenser packages	Foods, candies, cosmetics, drugs, toys, small parts, housewares, and personal items.
III.—Injection molding	Acetate, butyrate, styrene, impact styrene, acrylic, polyethylene, nylon, and other thermoplastics	Vials, decorative boxes, thin-wall disposable packages, re-use containers, aerosols, and specially designed functional packages	Foods, drugs and cosmetic items, personal products, hardware items, industrial parts, toys, and miscellaneous
IV.—Compression molding	Phenolic, urea, and melamine	Boxes, inhalers, aerosol containers	Tools, industrial and hardware items, face powder, colognes and other cosmetics
V.—Blow-molding and extrusion-fabrication	Polyethylene, vinyl, and nylon	Squeezable bottles, tubes and metal-end cans, aerosols, shipping drums, and related containers	Food products, shampoos, deodorants and other drug and cosmetic items, adhesives, chemicals, etc.
VI.—Extrusion of semi-rigid materials	Acetate, butyrate	Tubes and containers with separately applied bases and caps	Nails, screws, small hardware parts, toothbrushes, etc.
VII.—Molding or fabrication of cellular plastics	Expandable styrene beads, expanded styrene foam sheet stock, and vinyl and urethane foams	Boxes, carrying cases, form-fitting containers and package inserts for delicate parts, novelty re-use packages	Tools, electronic parts, easily damaged industrial or military components, food products, antibiotics, etc., requiring low temperature storage

What designers say about plastics in tomorrow's packages

Dave Chapman

"Designers and fabricators of packaging in its many forms are fully aware of the exciting potentials for the use of plastics in packaging. There is, however, a problem that must not be overlooked in considering what shapes and forms plastics packages for tomorrow will take. This problem is one of establishing the very importance of packaging *per se* as an effective sales tool for marketing divisions of our industrial management . . . Even though there is talk of 'plastics being too expensive,' if the use of plastics in packaging can add real plus values and appreciably increase sales, reduce breakage in shipment, display a product in a more favorable light, or offer re-use features—then an increased cost may account for itself many times over." . . .

DAVE CHAPMAN, INC.

Walter Landor

"We expect an accelerated upsurge in the use of plastics in packaging during the next few years. Technological advances coupled with reductions in cost and, above all, the evolution of new design concepts in the packaging of foods, drugs, hardware, and soft goods now in the development stage make this inevitable. We look for more creative applications of blister and skin packaging as high-speed thermoforming machines are perfected. This will open up vast fields in multiple packaging of canned foods and beverages, as well as in the area of single-service unit packaging.

"More emphasis will be placed on greater consumer convenience in the opening and closing of packages. Plastics will play a vital part. The plastic dispenser, both rigid-wall and squeeze-bottle type, will invade fields now largely dominated by metal, glass, and cardboard. The use of plastics tubes will grow. Squeeze bottle use will increase." . . .

WALTER LANDOR AND ASSOC.

J. Gordon Lippincott and Walter P. Margulies

"What's on the horizon for the next few years? We see these as the most likely.

"Egg packaging. A plastic carton, light, convenient, and inexpensive—probably of polyethylene. The egg itself may soon shed its shell and be marketed 'naked' except for a thin clear plastic covering. Economic advantages are obvious.

"Cereals, milk, and bread in plastics packages. A plastic wrap for bread is feasible . . . Plastic milk packages of linear polyethylene are another strong possibility . . . Present glassine liners for cereals, gelatins, and other dry foods could, and perhaps should, be replaced by plastics liners.

"Meat packaging. Plastics sprays look the most likely for enhancing the appetite appeal of meat packages.

"Improved opening and closing devices for all dry, free-flowing grocery products, detergents, and even cheeses.

"Increased use of rigid acetate in variety store and perhaps even grocery packaging."

. . . **LIPPINCOTT AND MARGULIES**

Jean Otis Reinecke

"Something new in plastics packaging. A package suitable for either vending or behind-the-counter merchandising and consisting of an antiseptically-sealed flexible conical cup container that holds a single dosage of liquid, powder, or tablet. The cover can be torn off and liquid added up to a marked level for exact dosage. Identification can be imprinted on the surface. The cup with the dose is packed semi-flat and opens up by squeezing after top is removed to hold the added liquid.

"This opens up the self-service market to a number of new products, such as drugs. It offers a new convenience to the housewife in mixing drinks for the children, e.g. cup might contain chocolate syrup to which milk can be added for a single serving.

"New areas of exploration remain . . . Direct-use containers . . . Reusable packaging . . . Incorporating merchandising ideas and premium items with plastics packaging . . . Dispensing devices of plastics." . . .

REINECKE AND ASSOC.

Walter Stern

"In order to advance plastic packaging in the world of selling, it must be endowed with characteristics beyond the production limitation boundaries.

"Increased competition and enlarged production facilities have lowered the basic cost of plastics . . . Physical characteristics have been greatly improved . . . Yet, plastics packaging seems to fall down in that other basic requirement: aesthetics.

"Institutional servings of jams, jellies, and marmalades in single-service portions have been limited to the conventional vacuum formed or deep-drawn vinyl cup with a vinyl film top seal.

"Contrast this with the appeal of a recently-introduced single-service portion of marmalade in styrene cups imitating cut-glass.

"Few of the possibilities in pre-forming or post-forming decoration have been exploited, nor the potentials of lithography, gravure, serigraphy, flocking, coloring, or other surface treatments fully utilized. There are essentially theatrical and magical excitements as yet unevoked in formed and molded plastic packaging.

"So far, sampling promotions have used plastics packaging primarily in the surgical and pharmaceutical fields. The exploration of other possibilities offer opportunities.

"If aesthetics are handled convincingly, there is no reason shortcakes, sundaes, applesauce, and puddings—even waffle and other batters to be baked—could not be handled in plastic packaging." . . . **WALTER STERN** of **RAYMOND LOEWY ASSOC.**

Metered amount of cream deodorant is dispensed from top of molded styrene tube when base is turned

Injection molded packages

Styrene container with polyethylene cover is now standard package. (Photo, Monsanto)

technique, a slide package, has been adapted to a blister-type unit being used by Tek-Hughes, Div. Johnson & Johnson, for a new line of hair brushes. The package, pressure formed by Plaxall, Inc., Long Island City, N. Y., from rolls of 15-gage Campco butyrate sheets, consists of an embossed slide-out blister over a paperboard base. Plaxall forms the domes at rates up to 90 per min., then feeds them into a special "Slide-plax" machine which turns the edges and produces the slide tracks for the paperboard base. This method eliminates the expense of heat-sealing equipment or the use of adhesives.

In addition to skin, blister, and contour packaging, thermoforming also has potential for turning out boxes, trays, cups, platforms, closures, dividers, and other packaging components. Here, too, the question is one of developing mass-production speeds. In this connection, one thermoformer already reports production speeds of 1000 units a minute for a series of small vinyl closures, while another has gone up to 15,000 units an hour on deep cup-type containers. Some of the new decorative printed or embossed plastics sheets may become important. A pre-flocked styrene sheet (supplied by The Gilman Bros. Co., Gilman, Conn.; flocking by Nashua Corp., Nashua, N. H.) seems to be well suited for luxury packages.

Film packages

Packages made by converting films into wraps, bags, pouches, and other forms comprise an ever-increasing outlet for plastics in the packaging field. Dry powders, liquids, oily products, foods, chemicals, toys, small hardware items, and a large variety of other products have already been packaged successfully in flexible film.

Polyethylene film, now less costly than cellophane, has become the workhorse of the plastics films used in packaging. Polyethylene wraps and bags for soft goods, housewares, tools, bread, and various fruits and vegetables have become a familiar sight in the nation's retail outlets. Even goldfish are being sold in polyethylene bags. And only recently, Crucible Steel Co. of America introduced a tough poly-

Compression molded packages

Metallized melamine aerosol (left) joins polyethylene bottle in packaging of toiletries

Bottles and tubes

First blow molded nylon aerosol (for hair spray) may mark breakthrough to important new packaging market for nylon materials

Versatile polyethylene squeeze package can even be used as dispensing unit for waterless skin cleanser. (Photo, Bradley Container)

ethylene envelope as a package for a heavy bar of one of its tool steels. The envelope not only serves to protect the precision-ground surface of the stock from rust, scratches, and grime but has many functional advantages for the consumer as well. The user simply peels back the pliable envelope to expose only the amount of the stock to the cut off for an individual job. After cutting, the polyethylene envelope may be rolled back to protect the remainder of the stock during storage. Inventory is thus always visible.

Other development work on the possibilities for polyethylene in the lucrative industrial market is being conducted by Spencer Chemical Co. with heavy-wall (10-mil) polyethylene bags designed to replace paper and other types of industrial shipping materials now in use. Results of two-year tests have shown the 50-lb.-capacity bags to withstand shipping and handling as well as, if not better than, paper. The bags seem to be a natural for materials which require moistureproofness, are corrosive, or require a minimum of contamination. In addition, the bags are sufficiently transparent to allow easy product identification; they can be used on standard filling equipment with minor modifications; they take up less storage space than paper bags; and can be palleted and loaded in the same way as an ordinary bag. Pricewise, Spencer believes that in quantity use, the bags will be competitive with other available materials.

In other areas, a big and as yet unexploited outlet for polyethylene film is in the form of an overwrap. Here, the principal drawback has been the relatively poor handling characteristics of the limp film on automatic wrapping equipment, plus the difficulty of making good heat seals through overlapping thicknesses of the material. A good deal of development work on these and related problems is currently underway—with seemingly good chances for success.

Another innovation in polyethylene film is a new extruded two-color film produced in tubular form by Plastics Packaging Co., Chicago, Ill. This process permits the extrusion of film combining two solid colors or one color plus a transparent section, affording various combinations.

A new high-density, low-cost polyethylene, called Boltathene and produced by Bolta Products Div., The General Tire & Rubber Co., is expected to increase polyethylene's stake in the heat-in-the-bag type of packaging (polyethyl-

ene is now used as a laminate with polyester for applications of this type). The company announces that the material can withstand temperatures up to 240° F. and does not lose its shape when placed in contact with boiling water.

Polymer-coated cellophanes are also moving strongly into the packaging picture. Du Pont's family of "K" cellophanes, for example, are supplied with a vinylidene chloride copolymer coating which provides better appearance, with more surface gloss and clarity, better product protection, and durability.

Acetate film has long enjoyed wide usage for many wrapping assignments calling for a "breathing" type of film. Excellent clarity, printability, and ease of fabrication are among its other attributes.

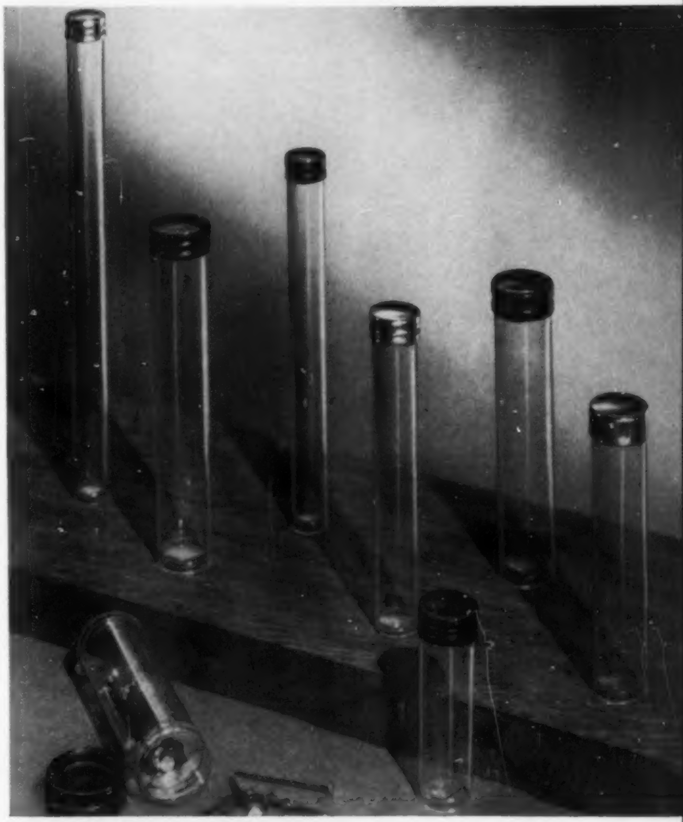
Vinyl film also enjoys extensive use, particularly as a transparent overwrap, where its combination of toughness and clarity proves highly desirable.

Saran film, with its exceptional chemical resistance and low moisture vapor transfer characteristics, has captured much of the market for cheese wraps and is also widely used in the form of a "chub" type package for cheese spreads, liver sausage, chili, and related products. This package, made from rolls of Saran tubing on automatic equipment which fills and seals the package on a continuous basis, is a pioneering example of automation in the packaging field.

Thin-gage oriented styrene film may have an excellent potential as a transparent overwrap. Now used for window envelopes, the film is low in cost and has excellent aging and sunlight resistance properties, thanks to the absence of plasticizer. It may also find its way into the production of candy pouches, hosiery envelopes, etc., where its high degree of transparency would not only be advantageous but also desirable.

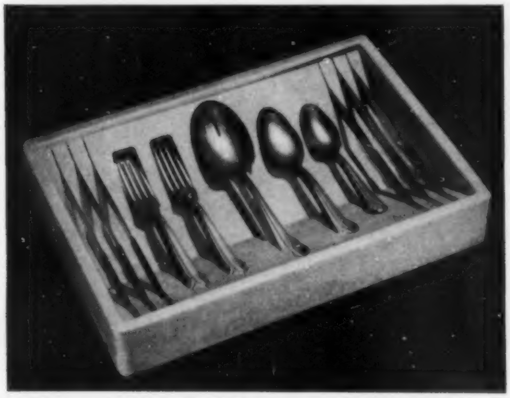
Nylon film and *fluorocarbon film* are two newcomers that bear watching. Even in very thin gages, nylon film has exceptional strength. A lamination of nylon and polyethylene film, thanks to the oil impermeability of nylon, could probably be used as a package for such products as motor oil and would be strong, light in weight, heat-sealable, economical, and easy to discard after dispensing of the contents. Fluorocarbon film, such as that (*To page* 222)

Extruded packages



Transparent extruded acetate containers are ideal packages for nails, screws, hardware items, or toothbrushes. (Photo, Eastman)

Foamed plastics packages



Tableware package molded of expandable styrene offers light weight, protection, and re-use value. (Photo, Ambassador Plastics)

Where plastics compete with concrete

1 **Reinforced plastics** shell of transformer vault is moved to position for installation

4 **Ground** is backfilled around vault body. (Photos, Westinghouse Electric Corp.)

Transformer vault of reinforced plastics is easily installed, durable, costs less than concrete

An ambition of many builders is to have "open sky" above their developments, with no ugly poles and wires. Until recently, trenching and the building of concrete underground vaults for transformers were so much more expensive than overhead power transmission with transformers on poles—sometimes as high as five times the cost—that few builders ever realized that ambition.

Easily installed

Now, Micarta Div. of Westinghouse Electric Corp. has developed for Chicago's Commonwealth Edison Co. a reinforced plastics underground transformer vault that 1) can be easily installed by two men, since its two parts weigh a total of only 300 lb.; 2) is a spacious 60⅜ in. wide for easy service; 3) is flame- and tamper-proof; 4) never needs painting; and 5) is so much lower in cost than cast-in-place weatherproof concrete that builders are getting interested.

The first installation was at Elk Grove Village, Ill., where 300 underground transformers (one to every eight houses) have been placed into service.

The new vault rests on a gravel base and is grounded by a wire screen molded into both casing and top. Over-all height is 84½ in., half of which is above ground. Thickness of walls is $^3/_{16}$ in. The "tube" or shell of the unit is made from woven roving, impregnated and wound on a mandrel. The dome is laid-up from woven roving on a polished steel form in a heated mold and pressed at very low pressure. Hetron flame-resistant polyester resin, supplied by Hooker Electrochemical Co., is pigmented green to blend in with the landscaped surroundings, thereby insuring a more attractive residential area unmarred by unsightly transmission poles and wires.

2 **Shell** is leveled on gravel bed prior to installation of electrical components

3 **Strengthening** rings are attached to the inside circumference of shell

5 **Transformer** unit is installed on mounting brackets attached to vault body

6 **Fibrous** glass-polyester cover with ventilating grilles is moved into position

7 **Cover is attached** to vault shell by means of hinges, can be readily removed

8 **Installation complete.** Green pigmentation of vault blends with landscape

Identification card is laid on adhesive side of acetate film. Dark part at top of film is strip of release paper. At left is a finished lamination. (Photos, Celanese Corp.)

Second acetate sheet is placed on top of bottom sheet. To effect lamination, finger pressure is exerted on the assembly and the edges trimmed to desired size

Press-less laminating

By the use of clear 5-mil acetate film, coated on one side with pressure-sensitive adhesive, identification cards, catalog sheets, price lists, and similar documents can now be laminated without the need for machinery, heat, or special skill.

Previously, this type of laminating was done primarily with acetate and vinyl sheeting on specialized equipment, and was consequently confined mostly to large-volume work. And while machine-laminations will undoubtedly continue to dominate the volume market, the introduction of the new acetate laminating film has now also opened the lucrative do-it-yourself field with its multi-million-pound-per-year potential.

The simplicity of the new process makes it a natural for the "amateur" market. The film, with the adhesive side protected by release paper, is supplied in various sizes to meet particular requirements. To make a lamination, the user strips off the paper, places the item to be laminated on the adhesive, places a second sheet on top, applies finger pressure over the area, and trims off any excess with a pair of household scissors. The whole operation takes about a minute—more or less—depending on the size of the lamination.

Several firms have already entered the field: American Kleer-Vu Plastics, Inc., Maspeth, N. Y., sells the sheet in kit form through Woolworth stores. Each kit contains twelve 4 by 4-in. sheets. Plain-Vu, P. O. Box 83, Mentor, Ohio, supplies sheets from 3 by 4 to 24 by 29½ inches. Self-Seel Plastic Co., P. O. Box 35005, Los Angeles 35, Calif., offers sheet in 3 by 4 and 9 to 12 inches. Louell Products Co., 246 Fifth Ave., New York 1, N. Y., sells 3- by 4- to 10- by 12-in. sizes. The last three companies sell the film direct.

Prices vary with the supplier, but average roughly 10¢ for a 3 by 4-in. lamination. A vinyl lamination of the same size costs about 15 cents. (It should be borne in mind, however, that the thickness of the vinyl used is about twice as much as that of the acetate and that the do-it-yourselfer does not have a charge for labor.)

The laminating sheet can also be used by students for protecting leaves, flowers, and similar specimens; by the homemaker for safeguarding her treasured recipes; and by almost anyone for a great variety of jobs.

Plastics make portable washer possible

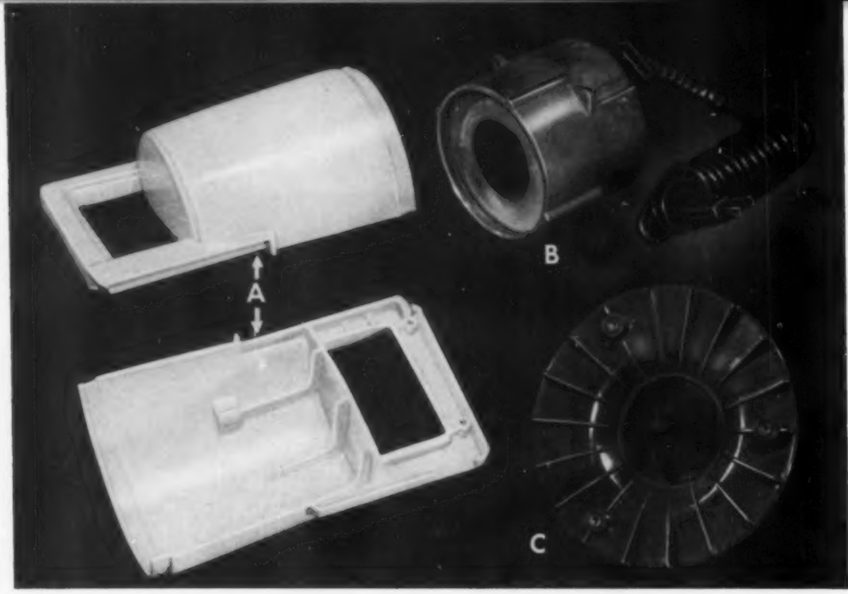
New concept in appliance design involves use of four kinds of plastics

Basically an electric motor surrounded by molded plastic parts, a 9¾-lb. portable clothes washer, introduced by AMI, Inc., Grand Rapids, Mich., again emphasizes the growing use of plastics by home appliance manufacturers. This handsomely styled unit, which efficiently washes and rinses up to 4 lb. of clothes in any wash basin, tub, or other suitable container, incorporates four basic plastics—phenolic, melamine, nylon, and epoxy. Together these materials provide increased visual appeal, safety, durability, portability, and corrosion resistance in the finished appliance, along with improved performance.

In use, the appliance is placed in a container, which is then filled with water to the proper level; vacuum cups hold the washer securely in position. The motor rotates a phenolic impeller or pump and simultaneously raises and lowers a molded nylon agitator by means of a cam ar-

Weighing less than 10 lb., portable washer can be used by homemaker in any available container. (Photos, Mel Boldt & Assoc.)

Particularly suitable for use wherever space is limited—small apartments, motels, etc.—washer can handle up to 4 lb. of clothes



Halves of combination handle and cover (A) are molded of off-white melamine. Motor (B), which mounts on internal studs in handle-cover, has its internal wiring encapsulated in epoxy, which provides a tight seal against water, dirt, and other foreign matter. Phenolic base (C) has molded-in inserts for attachment of metal base plate and rubber suction cups

rangement. The washing solution cascades over and into the center of the hollow base to the impeller. The impeller centrifugally forces the solution outward between the underside of the base molding and the metal base plate, setting up a constant circulation away from the base of the washer and back toward the agitator at the water surface level. Air drawn into the system aerates the solution and provides a lifting effect to move the clothes to the surface of the solution so that the currents produced by the impeller will move the clothes inward toward the reciprocating agitator.

Melamine housing and handle

Largest of the molded plastic parts involved is the combination housing and handle, compression molded of melamine in two matching halves. These parts are mounted directly on the motor housing and may be subjected to contact temperatures in excess of 100° C. (212° F.). Consequently, a plastic material combining high heat resistance, moisture and detergent resistance, and good impact properties was required. Selection of melamine for these components also permitted them to be run in an attractive off-white color.

The housing components weigh a total of 18½ ounces. They are produced in a two-cavity mold on a 200-ton compression press, using loose-powder loading. Each half has three internal stiffening ribs, two of which terminate in heavy bosses that are later drilled for attachment to mounting flanges on the motor. The handle portion, ribbed on the underside for a non-slip grip, is cored in the mold for assembly of the two halves by means of bolts and sleeve nuts. The back side of the handle is slotted to accommodate the electric cord and grommet. The notation, "Maximum Water Level," molded in relief on each half of the housing, is accompanied by a small dimple, which is filled in in red for increased visibility. After assembly, a metal trim strip is applied to a molded-in groove at the bottom of the housing.

In producing these cover parts, the molder sought to achieve good flow, glossy finish, and a minimum of finishing operations, along with dimensional accuracy to insure a matching fit between halves. Shrink fixtures are used to prevent warpage of the parts during cooling. A good pinch-off on the mold minimizes edge flash, permitting most finishing to be handled in a sanding operation. The center-to-edge dimension of each part is gauged with a checking fixture so left and right halves will fit perfectly.

Phenolic base and impeller

The base of the washer, molded of red agitator-type phenolic material, measures 6¾ in. in diameter by 2¾ in. high and weighs 6½ ounces. A series of 18 radial ribs on the underside of the base adds strength and rigidity and also serves to deflect the water outward as it leaves the impeller. Requirements for this part included good impact properties, uniform color, and adequate resistance to moisture and detergents. It is molded in a two-cavity mold run on a 250-ton compression press, using preforms and electronic preheating. Three molded-in in-

ternally threaded inserts provide a mounting for the rubber suction cups and the base plate. On the inside of the throat section of this component, flush with the top, are three cored flanges which provide attachment to integral legs.

Also molded of agitator-type black phenolic is the impeller, which has a maximum diameter of 2¾ in. and is designed with four vanes on the top. This part, which functions as a centrifugal pump, rotates at approximately 1550 r.p.m. when the washer is in full-load operation. It is produced in a two-cavity mold on a 100-ton compression press. A rib at the top of this part fits a slot at the bottom of a nylon cam shaft, affording attachment by means of a special ¼-in. screw.

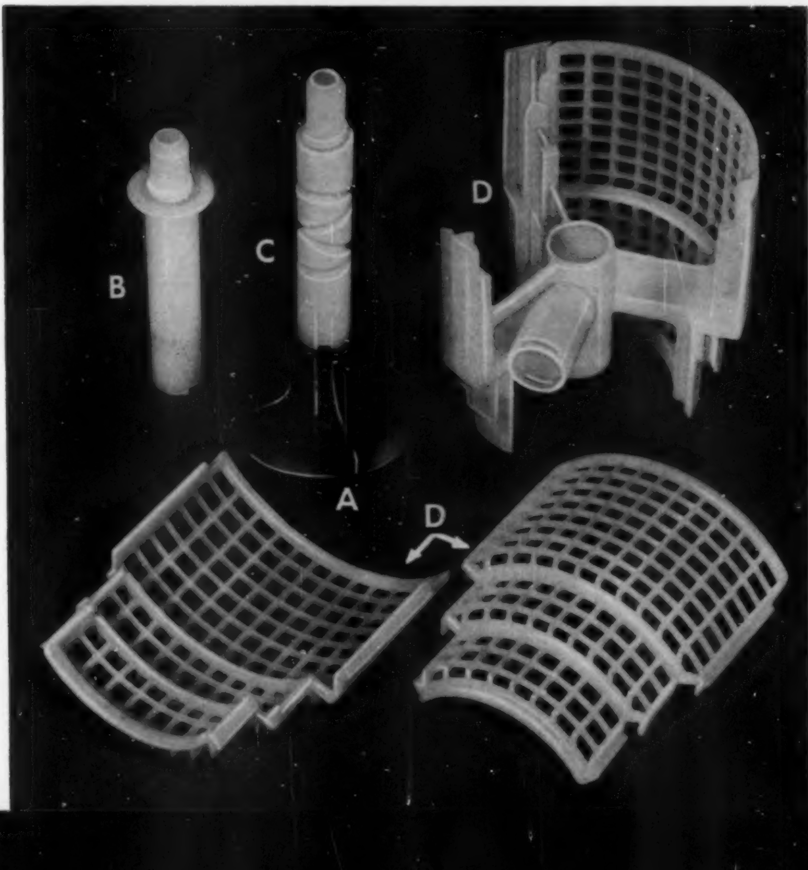
Nylon cams and agitator parts

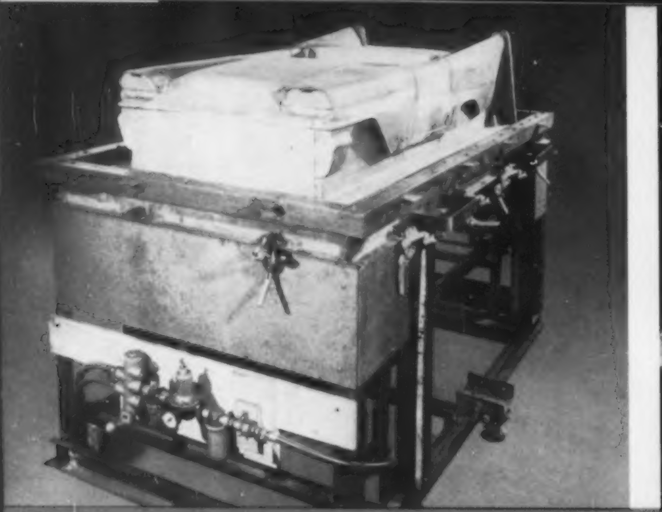
Injection molded nylon parts play a key role in the operation of the portable washer. They include the cam, the agitator hub, and three agitator sections.

The function of the grooved cam shaft is to translate the rotary action of the motor to a vertical motion of the agitator hub, causing the agitator to move rapidly up and down to produce a scrubbing action. The hub, designed with three arms to which the agitator sections are mounted, serves as a bearing which slides on the cam shaft. Radiating from the center of the hub, at the top, is a horizontal sleeve which houses a spring-loaded, stainless steel cam follower. Internal lubrication of this assembly is impossible, since the mechanical action takes place in a warm alkali washing solution which would soon wear away any lubrication. Nylon solves this problem, thanks to its excellent wear resistance and self-lubricating qualities.

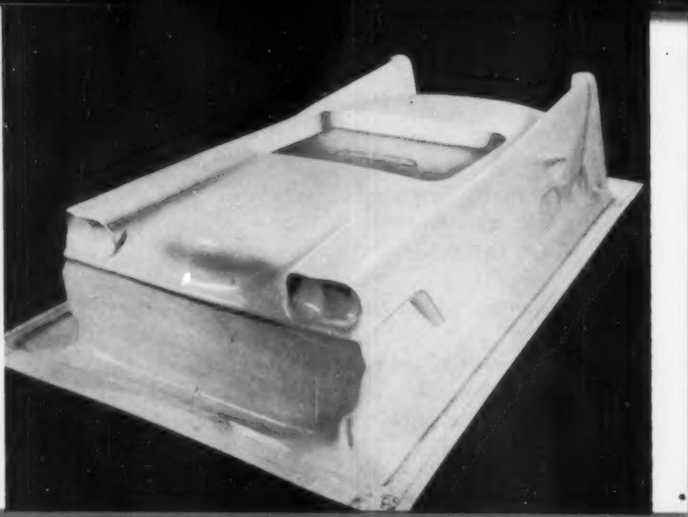
The curved agitator sections, having an intricate grille-like design, are snap-fitted to the hub and must be detachable to aid in removal of any lint which might accumulate during successive operations of the machine. Thus, a material was required which would be durable, yet flexible and able to maintain its shape. Nylon was the only material found to be practical, as well as functionally acceptable, for the *(To page 234)*

Except for molded phenolic impeller (A), all moving plastics parts of washer are made of nylon. Cam shaft (B) is injection molded with ring gate near upper end. After gate is removed, the shaft is finished (C) by machining spiral grooves into the part. Agitator consists of three identical molded sections (D) which snap in position on molded hub.





Wood-and-aluminum mold is assembled on wheeled table, which is then rolled under sheet-heating tunnel oven



Miniature car body as it comes off mold. Part was formed from a 45-lb. sheet of impact styrene

Thermoformed

As a premium to hard-selling dealers throughout the country, the DeSoto Motor Corp., Div. of Chrysler Corp., is offering a miniature plastic-bodied model of the 1958 DeSoto convertible. Big enough to hold two children, the model is powered by a lawn mower motor.

The body and the trim are made by Halsen Mfg. Co., Philadelphia, Pa., entirely out of plastics, while the chassis is manufactured by Robel Corp., Berwick, Pa. The body is one of the biggest vacuum forming jobs ever tackled. It is made from a ¼-in. thick white impact styrene sheet supplied by The Gilman Brothers Company, Gilman, Conn., under the tradename of Gilco. The sheet, produced from Dow material, weighs 45 lb.; the finished piece, after forming and trimming, weighs a little over 30 pounds.

The job was turned out on special equipment developed by Halsen for forming big pieces. The male mold, made of wood and aluminum, sits on a wheeled table which also incorporates heating and cooling equipment and vacuum lines. The table with its mold is pushed on tracks under a zone-controlled overhead tunnel oven, which then heats the material to be formed.

The sheet in its frame drops down to mate with the frame around the bottom of the mold; vacuum is drawn, and in 15 min. the complete, cooled part is removed. The trick here is that the mold itself comes apart for easy removal and reassembly. The aluminum parts of the mold are located where a fast chill is required on the deepest drawn parts.

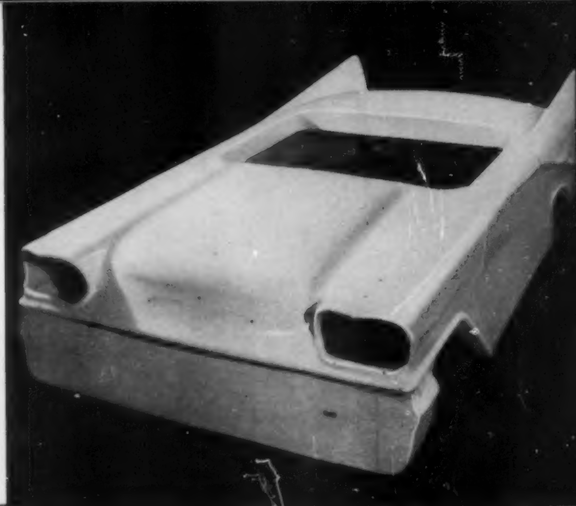
Plastic trim

Aside from the body itself, the trim is an interesting combination of plastics materials. The twin headlamp frames and tail light trim are vacuum formed from polystyrene sheet material and then metallized. Hubcaps, front grille, and back bumper are formed from Gilco impact styrene sheet and then metallized. Trickiest small part, from the standpoint of production, is a little epoxy frame used to hold a license plate on the back of the car. To make the frame, a wooden model was first created; then, a 20-gage polyethylene sheet was vacuum formed over that model to become a mold for the cast epoxy frame. Louis Bender, head of Halsen, mixed up his metallized epoxy compound, put it into a polyethylene squeeze bottle and literally cast-squeezed it into the polyethylene mold. The frame is later vacuum metallized.

The red tail lights are formed from transparent red vinyl sheet.

According to Mr. Bender, the principle of take-apart molds for big piece vacuum forming is a significant trend. Using this technique, different metals and other materials can be used in various parts of the mold, and with proper engineering can be heated or chilled as desired. And when a thermoformer is working on a piece of this size, he cannot afford rejects.

Inside view of formed, untrimmed automobile body. (Photos, The Dow Chemical Co.)

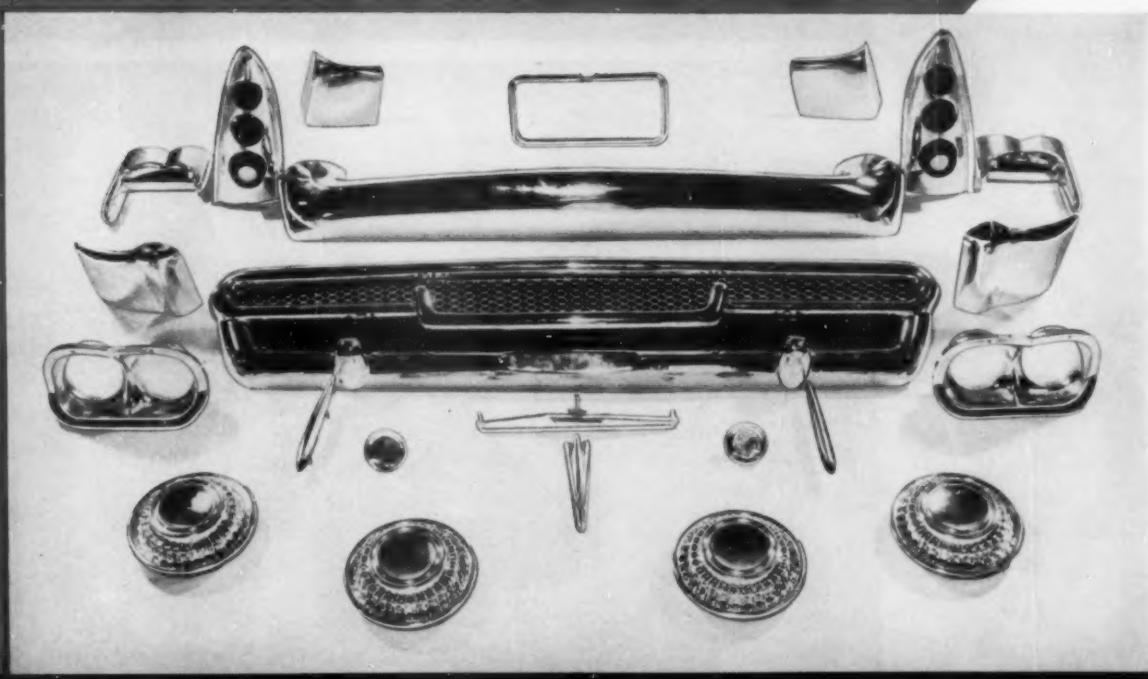


Trimmed body, weighing approximately 30 lb., ready for assembly to chassis and installation of trim

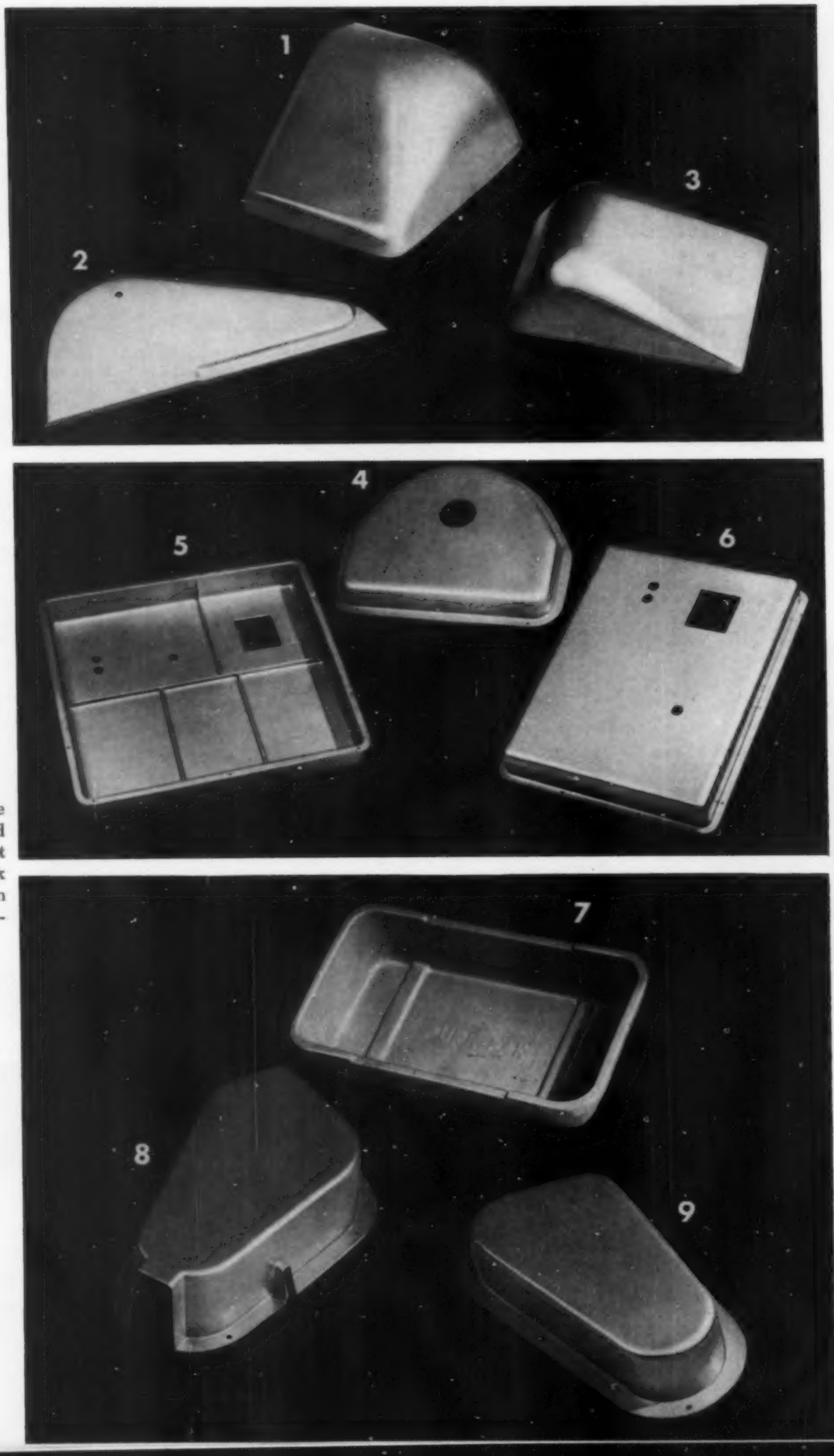
junior De Soto

Special equipment and techniques are used to form large styrene sheets into model auto bodies, each weighing over 30 pounds

All trim parts are vacuum formed, except for the epoxy license plate frame (center background) which is cast in a vacuum formed polyethylene mold. All parts are metallized



Plastics cut costs



Nine parts formerly made of metal and now produced of plastics at savings in cost and weight. Numbers link to designations in table on facing page. (Photos, Ex-Cell-O Corp.)

in machine tools

*By Ernest Quastler**

Replacement of metal parts by plastics resulted in cost reductions up to 71% and savings in weight of up to 95 percent

While plastics have, of course, already made a lasting impact on many industrial applications, the use of the material in component parts for machine tools and similar large machinery seems to be a relatively unexplored area. These applications should be explored further, particularly since the results of tests which we have conducted over the past two years show plastics to be in a highly favorable competitive position. The comparison we made between the metal and the plastics components showed some interesting results. In every instance, the weight of the finished piece was drastically cut—in one case from a total of 23 lb. down to a single pound. Even more exciting was the fact that, *again* in every instance, costs were reduced by percentages that ran from 16% to as high as 71 percent. These weight and cost savings are tabulated in the accompanying chart. In all cases, costs were computed for the completely finished machined parts.

In addition, the plastics components stood up very well in use and further allowed the engineer greater flexibility in designing the pieces for ease of assembly and installation. All plastics parts were of one-piece design, whereas some of the metal parts required subsequent assembly.

Although it was not necessary to finish the plastics parts in any way, they were spray-painted in a metallic color to match the rest of the machine. The ease of painting plastics without the need of prime coating the surface constituted another advantage. Painting costs were not considered in the cost evaluation.

*Production Development, Ex-Cell-O Corp., Detroit, Mich.

WEIGHT AND COST SAVED AFTER CHANGE TO PLASTICS[1]

Item number[2]	Part	Approximate outside dimensions, in.	Original material used	Weight lb.	Plastics	Weight lb.	Weight reduction %	Cost reduction %
1	Cover	17 x 11½ x 8	Aluminum casting	11	Fibrous glass-reinforced polyester resin[5]	3	73	16
2	Cover	19 x 7¾ x ⅞		3		1½	50	25
3	Cover	12½ x 10 x 6		6		2	66	43
4	Motor cover	22 x 17 x 2½		4½		1¾	61	25
5	Electric panel cover	21½ x 21½ x 2½		15		5	66	71
6	Electric panel cover	21½ x 16½ x 2½		13		4	69	47
7	Container for hot liquid[3]	20 x 12 x 4	Deep drawn sheet metal, galvanized	7½	Thermoformed ABS polymer sheet[6]	1¼	83	27
8	Gear guard[4]	16½ x 11 x 3¾	Cast iron	20		1	95	47
			Sheet metal	3			66	[illegible]7
9	Gear guard[4]	13 x 11 x 3	Aluminum casting	5½		¾	86	40
			Sheet metal	2½			70	56

[1]Cost and weight evaluation based on two-year test conducted by Ex-Cell-O Corp., builders of machine tools.
[2]Numbers relate to parts illustrated on opposite page.
[3]Successfully tested for holding hot paraffin at 180° F.
[4]Plastics gear guards were evaluated against two different types of metal models.
[5]Majority of reinforced plastics parts were matched metal molded.
[6]All parts were formed of acrylonitrile-butadiene-styrene sheet approximately ⅛-in. thick.

HOW TO SLUSH

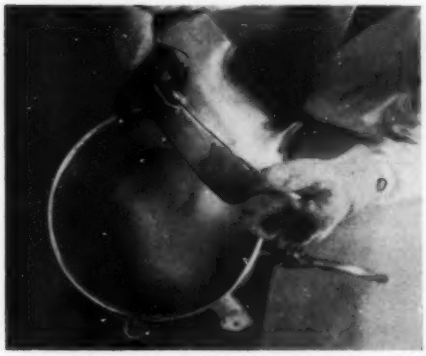
Toy animals slush molded of polyethylene can be produced at low tooling cost

Slush molding, a processing technique long used exclusively with vinyl plastisols, has now become available to polyethylene as well, and the first commercial applications are already on market. Advantages of the process are 1) inexpensive equipment; 2) low-cost, simple molds; and 3) the opportunity of making certain types of hollow objects that are generally difficult or impossible to produce by any other means.

Slush molding is a method for casting thermoplastics by pouring the resin in liquid form into a mold where it fuses to form a viscous skin against the wall. The excess slush is

Slush molding a duck

1 **Four-part** mold is assembled for slush molding polyethylene duck decoy



3 **Water-white slush** is poured off after coating has solidified on walls

MOLD POLYETHYLENE

Blends of low-molecular-weight and standard resins make technique feasible. Mold and equipment costs are low. Several products are already on the market

drained off, the mold cooled, and the molding removed.

The chief benefit of polyethylene in slush molding is that it overcomes all problems associated with plasticizers used in vinyl slush molding. On the other hand, vinyl is superior in two important respects: it has greater tensile strength and can be stripped from the mold, permitting the use of undercuts. In slush molding polyethylene, the mold must come apart to remove undercut objects.

Standard polyethylene cannot be used for slush molding because, even when melted, it is too viscous to permit residue material to be poured out of a mold after the walls have been coated. But with the addition of enough low-molecular-weight (LMW) polyethylene, the hot material pours easily.

Taking cognizance of this fact, Allied Chemical's Semet-Solvay Petrochemical Div. is pursuing the slush molding market with its low-molecular-weight AC polyethylene. Eastman Chemical Products has also been grooming its Epolene C, another LMW material, for slush molding applications.

Allied has found that viscosities between 5000 and 10,000 centipoises (cp., approximately the consistency of corn sirup) at 300° F. are

decoy of polyethylene

2 **Blend** of molten polyethylenes is dispensed into mold held together by clamp

4 **Mold** is taken apart and finished polyethylene duck decoy removed

Close-up of molded decoys. Since flash does not affect appearance and utility of product, it need not be removed. (Photos, Allied Chemical Corp.)

Which is the polyethylene? Display candy molded of blend of high- and low-molecular-weight polyethylenes (top) cannot be distinguished by eye from the real article (below)

the most useful for slush molding. Any blend of LMW polyethylene with conventional material that will produce viscosities within this range is suitable. Viscosities below 5000 cp. produce a weak molding; above 10,000 cp. the plastic is too thick to pour properly.

The material should be blended at 300 to 350° F. with the high-molecular-weight material added after the LMW polyethylene is already molten. Optimum molding temperature range, according to Allied, is from 280 to 350° F.

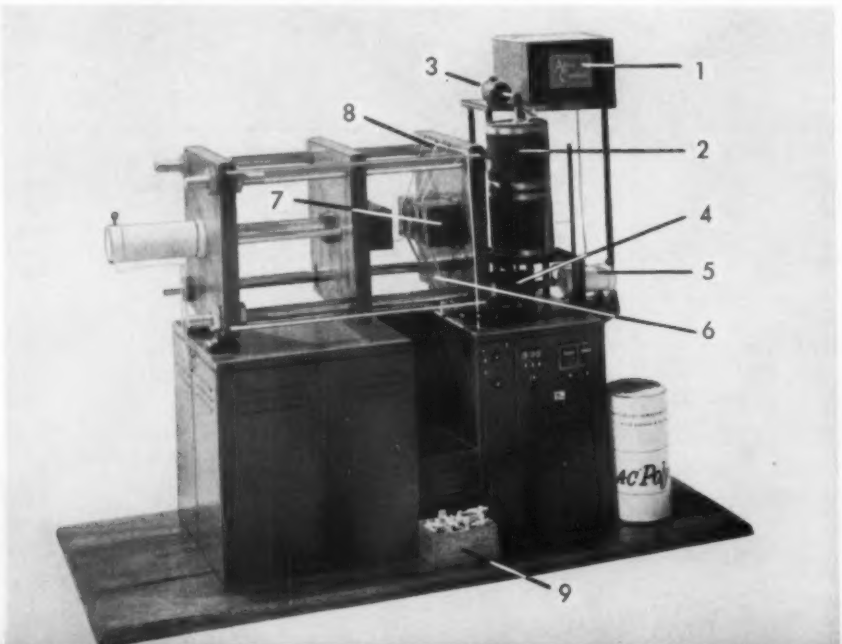
The wall thickness or weight of the finished object depends on the pouring temperature, the viscosity of the material, and the time allowed before the slush is poured off. In general, the use of high temperature and low viscosity gives the lowest weight.

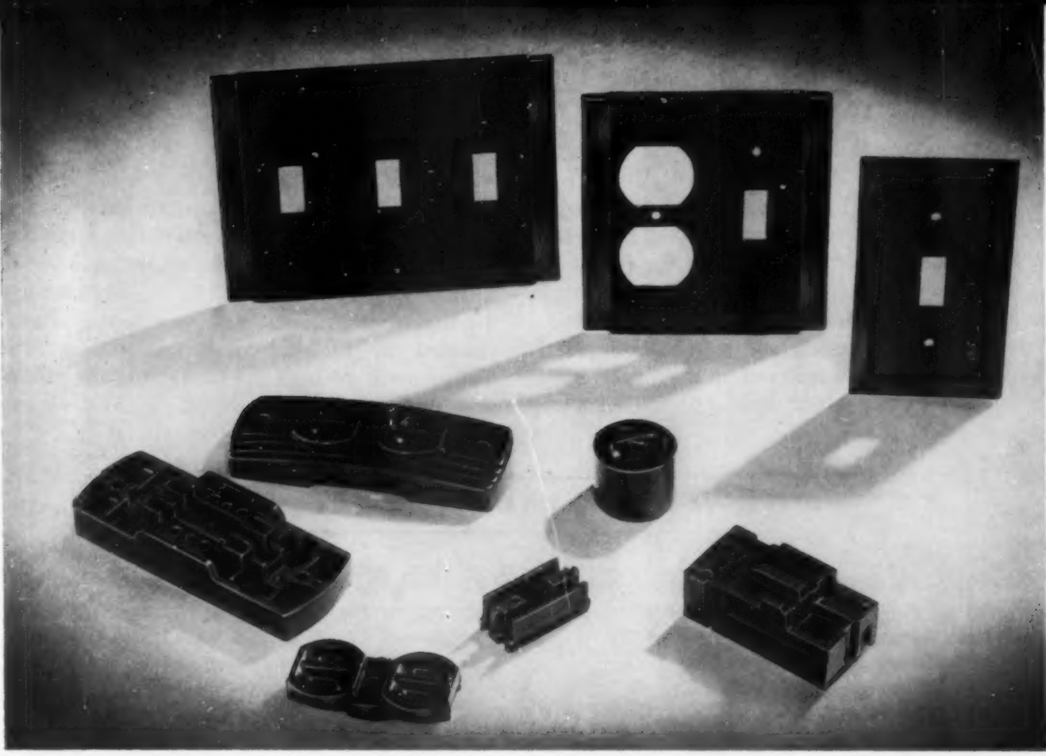
Quick pouring is essential to a smooth finish; slow filling produces a wrinkled finish. In the Allied test work, a hand-poured 1-oz. product took 20 to 25 sec. to fill and 30 sec. to drain.

Of course, much faster cycles can be obtained with the use of production equipment. Along these lines, Allied has designed a prototype machine to make the process more automatic. It raises polyethylene to the molding temperature, blends the LMW polyethylene with the high-molecular-weight material and feeds the blend into the mold.

The commercial applications of slush molded polyethylene to date, illustrated on these pages, include a line of toy animals molded by J. H. Miller Mfg. Co., Quincy, Ill., and polyethylene copies of natural food products made by Knechtel Laboratories, Chicago, Ill. Knechtel, which makes candy, cheese, and cookies for display purposes, offers such realistic "chocolate" box candy that many unwary victims have bitten into the pieces. The polyethylene candies, which are solid and not hollow, are made exactly like the real thing: the ingredients are mixed, heated, poured into open molds, and allowed to cool.

Prototype of machine for automatic slush molding. Mixture of high- and low-molecular-weight polyethylene granules is placed in hopper (1), heated in cylinder (2) and blended by mixer (3). Molten blend goes into "injection" cylinder (4) where ram (5) feeds it through pipes (6) into mold (7). After desired wall thickness has solidified, excess material is drawn out of mold on the backward stroke of the ram. To keep product from collapsing, special lines (8) feed air into mold. At end of cycle, mold opens and part drops out (9)





Wiring devices and switch plates test-molded of wood-flour-filled urea. The good arc resistance of the material is claimed to make it especially suitable for electrical applications

Why not wood-flour-filled urea?

Largely neglected in the United States, material has found wide application in England; may be slated for comeback here

Buyers of custom molded plastics might be expected to show an interest in a thermosetting molding compound which would be competitive with phenolic in price, equal it in hardness and inertness to chemical and pharmaceutical reagents, and surpass it in arc resistance and lightfastness.

Wood-flour-filled urea is claimed to be such a material. While it has been produced and sold in England in a variety of grades for over two decades, it has been largely ignored in the United States during recent years. Actually, major U. S. producers were never more than half-hearted in their efforts to commercialize this product. In fact, the foremost American producer discontinued its 3 to 5 million lb. annual production some two years ago. Its material consisted chiefly of a low-cost, brown, general-purpose grade intended for wiring devices and electrical parts requiring high arc resistance. The material is now being reevaluated, and some U. S. amino producers are wondering if the British-type wood-flour-filled urea, highly refined, might not find a market here.

The picture in Great Britain

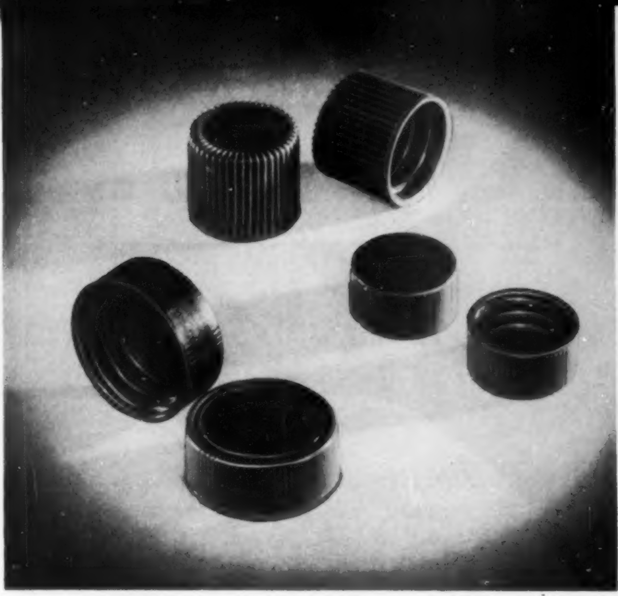
In England last year 40 million lb. of amino plastic molding materials were made. The bulk of this production was urea formaldehyde, both of the paper- or alpha-cellulose-filled type and the wood-flour-filled variety. While a statistical breakdown for the two kinds of urea compounds

is not maintained by the British government, it is generally accepted that wood-filled materials constitute a substantial portion of the total.

The majority of British producers of urea compounds manufacture the wood-filled type; one producer is understood to manufacture it exclusively. A wide range of properties is available and considerable choice is possible with respect to color, plasticity, particle size, rate of cure, surface luster, and after-shrinkage. Improvements in quality and performance versatility have been substantial in recent years and the materials continue to offer a valuable supplement to cellulose-filled compounds. The maintenance of high standards for the wood-filled materials in England is insured by

Physical properties of urea with two types of filler

Property	*Alpha-cellulose-filled*	*Wood-flour-filled*
Compression ratio (bulk factor)	2.5	2.5
Tabletting	Excellent	Excellent
Plasticity range	Very soft to hard	Medium
Moldability in compression molds	Excellent	Excellent
Compression molding temp., °F.	275-350	275-320
Compression molding pressure, p.s.i.	2000-8000	2000-5000
Moldability in transfer molds	Special	Subject
Transfer molding temp., °F.	type	to
Transfer molding pressure, p.s.i.	recommend	trial
Shrinkage (4 by 1/8 in. disk, CMCP),—in./in.	0.006-0.009	0.007-0.008
Additional shrinkage (48 hr. at 22°F.), in./in.	0.006-0.012	0.006-0.008
Specific gravity	1.5	1.52
Molded density, g./in.^{3}	24.6	25.0
Machining quality	Good	Good
Flammability	Self-exting.	Self-exting.
Light transmission, %	21.8	0
Resistance to sunlight	Pastels gray	Fades
Impact strength, izod, milled, ft.-lb./in. of notch	0.24-0.28	0.26-0.275
Flexural strength (1/4- by 1/2- by 5-in. bar) p.s.i.	11,000-18,000	10,000-13,000
Deflection (1/4- by 1/2- by 5-in. bar), in.	0.103-0.157	0.100-0.120
Dielectric strength (1/8-in. section in oil):		
Short time, v./mil at 25°C.	330-370	340-370
v./mil at 100°C.	200-270	220-250
Step-by-step, v./mil at 25°C.	220-250	220-240
v./mil at 100°C.	110-150	140
Slow-rate-of-rise, v./mil at 25°C.	250-260	230-240
v./mil at 100°C.	120-170	130-150
Volume resistivity, ohm-cm.	$0.5\text{-}5.0\times10^{11}$	$5.0\text{-}8.0\times10^{10}$
Surface resistivity, ohms	$0.4\text{-}3.0\times10^{11}$	$1.0\text{-}2.0\times10^{11}$
Insulation resistance, ohms	$0.2\text{-}5.0\times10^{10}$	$1.5\text{-}2.0\times10^{10}$
Dielectric constant, 60 cycles	7.7-7.9	7.2-7.3
Dielectric constant, 1000 cycles	7.3-7.5	6.8
Dielectric constant, 1,000,000 cycles	6.7-6.9	6.4-6.3
Dissipation factor (60 cycles), %	3.6-4.3	4.2-4.4
Dissipation factor (1000 cycles), %	2.7-3.1	2.5-2.6
Dissipation factor (1,000,000 cycles), %	2.9-3.1	2.7-2.9
Dielectric loss factor, 60 cycles	0.28-0.34	0.30-0.32
Dielectric loss factor, 1000 cycles	0.20-0.23	0.17-0.18
Dielectric loss factor, 1,000,000 cycles	0.19-0.21	0.17-0.19
Arc resistance, sec.	79-100	85-110
Surface breakdown ratio	0.43-0.51	0.39-0.54
Rim arc resistance, breaks per revolution	0-0-0	0-0-0



Wood-flour-filled urea closures molded by Mack Molding, Ltd., Canada, of material supplied by British Industrial Plastics

Pastel toilet seat molded by J. Ferguson & Sons, England, has good surface finish

strict compliance with British Standard 1322 U, which was established specifically for this type of material.

Color quality

For many applications the wood-filled product is claimed to be as satisfactory as the cellulose-filled type, the only substantial difference between the two varieties reportedly being in the relative opacity and hence color quality. The good translucency of the alpha-cellulose-filled product cannot be equalled by the wood-fllled material; thus, general color clarity and color depth are to some degree inferior in the wood-filled product. Other properties, however, such as arc resistance and electrical insulation, hardness, lightfastness, and inertness to chemical and pharmaceutical reagents—which have served to establish urea as a molding material for many applications in England—are generally similar in both. (See table on opposite page.)

Among the types of wood-flour-filled urea produced in Britain is a new high-quality molding powder in attractive color ranges designed to impart to moldings an exceptionally good surface finish. Also included is a general-purpose wood-flour-filled urea in unlimited opaque colors, and a plasticized wood-flour-filled urea designed for good dimensional stability.

The material is said to be tasteless and odorless, resistant to tracking and free from attack by most organic solvents. Producers recommend it for electrical components, telephone handsets, radio cabinets, toilet seats, bottle closures, tableware, clock cases, light fixtures, and buttons.

Wood-flour-filled urea has also been long recognized in England as a good material for molding toys, games, and nursery items. They are easy to keep clean and are non-toxic and colorfast.

U. S. potential

It appears that the largest potential applications for wood-flour-filled urea in this country would be in wiring devices and closures—applications presently dominated by general-purpose phenolic and standard urea.

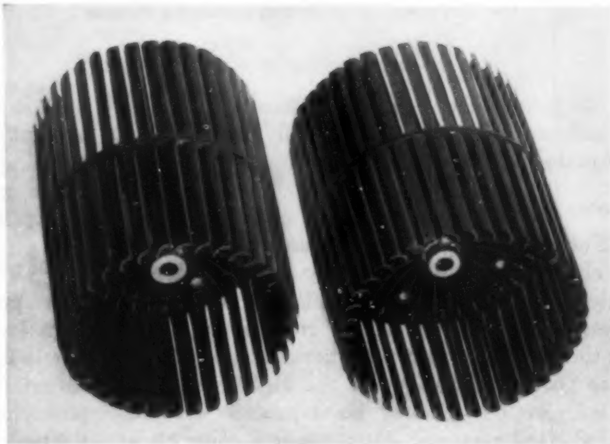
The predominant factor in developing large wood-flour-filled urea usage in the wiring devices field depends, of course, upon the degree to which phenolic can be displaced. With the two materials priced competitively, the answer to this question rests chiefly on superior arc resistance and on possibly subtle advantages in urea's molding performance.

A potentially significant factor in the closures field is the superior lightfastness of the wood-flour-filled urea compound over phenolic in colors other than brown and black. In addition to lightfastness there is a substantial economic advantage of producing colors at a price lower than any other equivalently colored plastic.

However, it is important to keep in mind that wood-flour-filled urea cannot replace phenolic in every category; there are substantial areas, for instance, where heat limitations curtail its use. Nor is it always possible for the phenolic molder to switch to wood-flour-filled urea, chiefly because of the shrinkage variations between the two materials. When molds are built to close tolerances, this factor obviously makes the switch impractical.

Blower wheels:

Close-up of molded phenolic blower wheel used in wall unit illustrated on opposite page. (Illustrations, Denbo)



Phenolic blower wheels can be assembled in double units, with one part having a different blade length than the other, for custom installations and special jobs

Just as 10 years ago phenolics took over from metals in washing machine agitators because of the plastic's resistance to alkalies and detergent chemicals, they are now taking over from metals in blower wheels for heating and air conditioning units. And they are proving themselves as efficient in moving air as they did in moving water.

Denbo Engineering and Sales Co., Inc., Indianapolis, Ind., has designed and is having produced a line of four phenolic blower wheels ranging from 5⅜ to 8 in. in diameter. The blade sections are aerodynamically designed, an achievement which was economically impractical in fabricated metal. One-piece construction results in silent operation, higher air delivery efficiency than could be obtained with metal, and dimensional stability in a wide range of temperatures.

General-purpose phenolic was chosen for the application because of rigidity, heat resistance, hard surface finish, lack of cold flow and creep, high flexural strength, resistance to corrosive gases, low specific gravity, and price.

Versatility in various blower applications is obtained by combining double units with different lengths of blades; the molding tools were built to permit both clockwise and counterclockwise operation. Among the first end-users of the new blower wheels was Electrend Products Corp., St. Joseph, Mich. They are used in an electric wall heating unit which fits into a standard stud partition space as shown in the accompanying illustrations. With this device, warm air at ceiling level is drawn into the wall-enclosed duct, reheated, and issued at floor level so that usually wasted ceiling heat is used to best advantage in the lower portion of the room.

Electrend reports that the cost of the wheels was competitive and in many cases less than those made of other materials, that there has

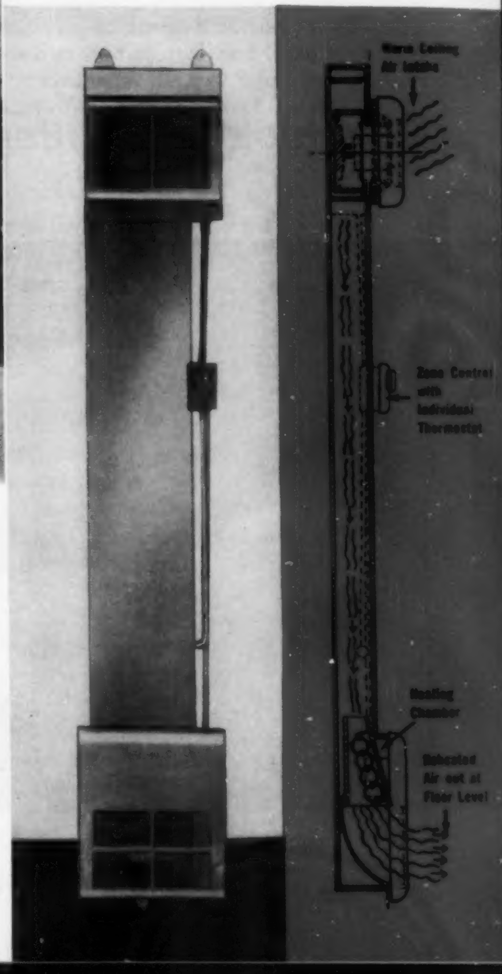
new field for phenolics

been no warpage or twist in either shipment or use, and that specifications have been rigidly maintained.

Considering the fact that in 1957 over 1.6 million window or room air conditioners were produced, each requiring some air moving device, considering the fact that that market is expected to reach at least 1.8 million units in 1958, and considering that at least 200,000 air conditioned automobiles will be marketed this year, the prospects for phenolics in blower wheels look very good.

Credits: Molder—Kurz-Kasch, Inc., Dayton, Ohio. General-purpose phenolic material—Durez Plastics, Div. Hooker Electrochemical Co., N. Tonawanda, N. Y.

Motor unit, with blower wheel mounted to it, is installed in flat duct of a wall air heating unit



Over-all view of wall unit. At extreme right is drawing of duct showing location of blower wheel

PLASTICS PRODUCTS

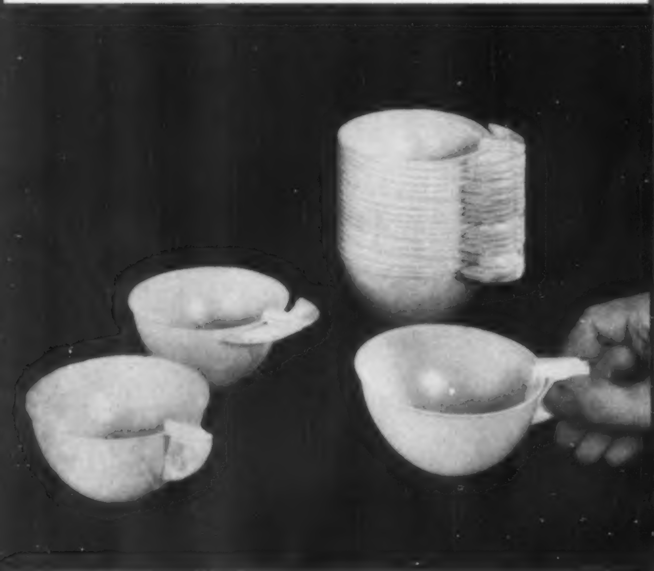
Disposable cup

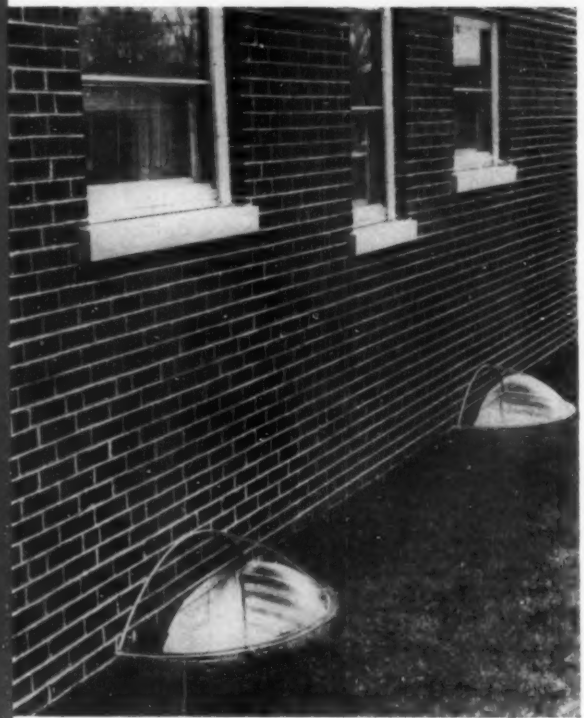
Priced at a competitive $14 per 1000, the newest entry in the field of plastics disposables is a cup for hot liquids, vacuum formed of heat-resistant polystyrene in the shape of the familiar china cup. A folding handle, formed as part of the cup, locks in slip-proof grooves formed into the sides. Because plastics are poor thermal conductors, little heat is transmitted to either the handle or the lip.

The cup, which has a 7-oz. capacity, is produced on specially designed vacuum forming equipment. It was originally developed for drive-in trade and in-plant food service; however, institutional and consumer uses are anticipated.

For bulk shipment, 50 cups are packed to a paper bag, with 20 bags in a shipping carton. Total weight: 17 pounds.

Credits: Formed by Federal Tool Corp., 3600 W. Pratt Blvd., Chicago 45, Ill.; polystyrene by The Dow Chemical Co.





Window well dome

A free-blown acrylic "bubble canopy," similar to those used on military aircraft, has been developed for home use as a protective cover for basement window wells. The transparent canopy allows full light passage while keeping window wells dry, clean, and free from rain and snow, as well as leaves and paper that hold moisture and create odors.

The shatter-proof Accro-Dome, which measures 44 by 22 by 11 in., can be easily installed by the home owner. It is held in place by two wire brackets which are bolted through two holes drilled in the corrugated metal liner inside the window well. A vinyl weather seal strip applied to the back edge of the dome fits tightly against the side of the building, while an air space under the rim allows free ventilation.

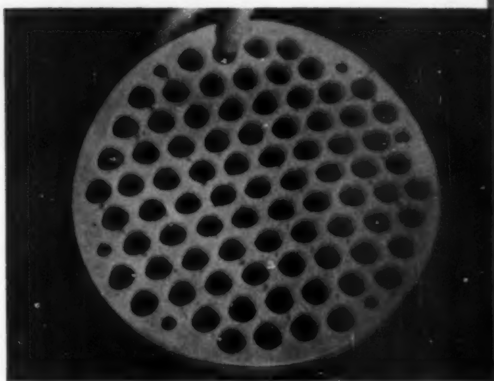
Credits: Manufactured by Accro Plastics, 3272 W. Fullerton Ave., Chicago 47, Ill., of Rohm & Haas Plexiglas acrylic.

Vinyl foam pillows

Molded vinyl foam throw pillows that can easily be covered at home are now being offered to the housewife through retail outlets. Internal cores, designed to reduce weight and provide additional resilience, are molded directly into the cushions. The cushions are molded in two halves which are then laminated together. Both square and round pillows are available in 12- and 14-in. sizes, which taper from a depth of 4½ in. at the crown to 2½ in. at the edge.

Advantages of the vinyl foam pillows include flame-resistance, dimensional stability, superior tensile strength, and the fact that they will not lump or sag.

Credits: Molded by Cambridge Rubber Co., Taneytown, Md., under license from Elastomer Chemical Corp., unit of Union Carbide Corp.

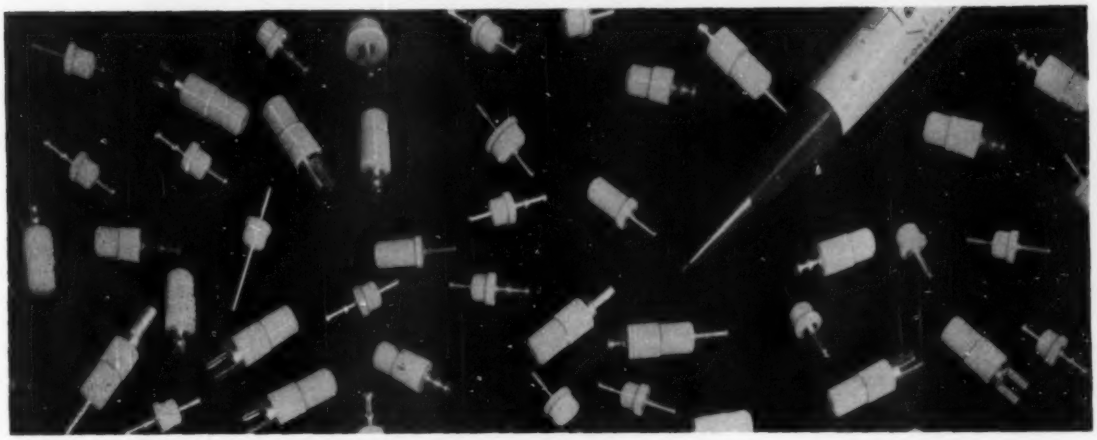


Polyethylene blocks

Polyethylene invasion of the toy field is continuing at a fast and torrid pace. Latest product to join the swing is a set of polyethylene building blocks—virtually indestructible—soft and flexible enough so that the child can neither hurt himself nor damage floors or furniture.

The injection molded blocks can be used to construct a variety of scale models, including a bakery, an auto sales store, a theater, houses, a shoe store, and a supermarket. Because the precision molded blocks are designed to interlock, the finished scale stores are exceptionally rigid. The sets also include molded polystyrene store fronts and theater marquees that add another touch of realism to a miniature Main Street.

Credits: Manufactured by Gibbs Automatic Molding Corp., Henderson, Ky., from polyethylene supplied by Spencer Chemical Co., Dwight Bldg., Kansas City 5, Mo.



Miniature electrical terminals machined of Teflon tetrafluoroethylene resin. These tiny pieces are produced to tolerances of ±½ mil

Machining TFE resins

TFE machining requires close control of rod stock quality and allowance for TFE's special machining problems: limberness, stress relief, plastic memory, and slow heat conduction

By H. Jack Kipnes[†]

Unlike other thermoplastics, TFE resin does not flow well in its melted state, and this, plus the fact that it is molded at extremely high temperatures, makes it difficult to mold the material to close tolerances. For this reason, TFE parts must be machined from rod stock when close tolerances must be met. The unique extrusion and molding characteristics of TFE also impart some peculiarities to machining stocks; its surface properties and cutting characteristics are unlike those of other commonly machined materials, even those of other plastics. Soft, waxy, and springy, TFE resin, according to machinists, has the cutting "feel" of brass and, surprisingly, the abrasiveness of stainless steel. Just as certain special practices are recommended in machining cast iron, cold-rolled steel, aluminum, lead, etc., so have certain techniques been found useful in machining TFE resin. Through the use of these techniques, it is possible to make many TFE parts that would otherwise be impossible or impractical.

So much progress has been made in machining this interesting material that we are now producing, in commercial quantities, a wide variety of "micro-machined" TFE parts, parts so small that a teaspoon can hold several hundred (see Fig. 1, p. 124). On such parts, tolerances of 1 mil are not unusual, and in some cases ½-mil tolerances have been maintained.

Rod quality is important

The bulk of machined parts can be made economically from extruded or molded rod stocks

*Reg. U.S. Pat. Off.
†Chief Engineer, Tri-Point Plastics, Inc. Albertson, N. Y.

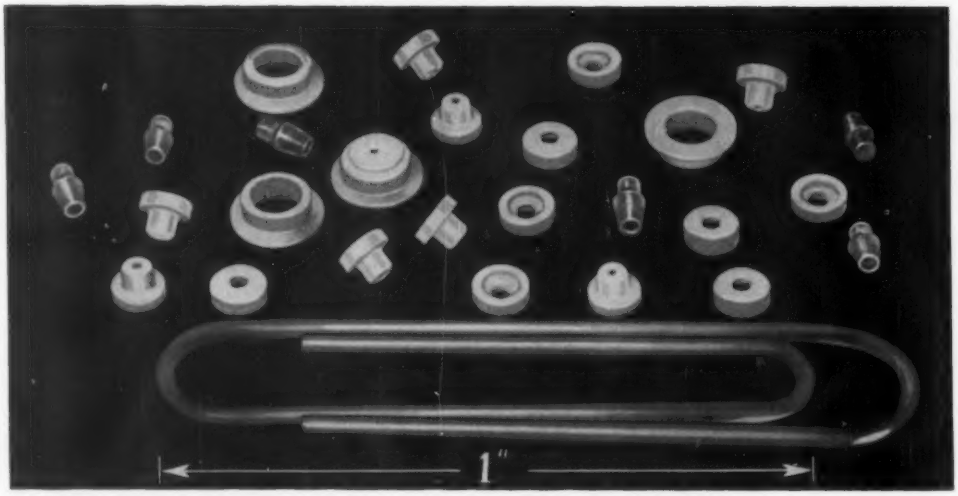


Fig. 1: Typical small TFE parts. Large object in foreground is ordinary paper clip

ranging from ⅛ to 2 in. and more in diameter. To minimize waste of this expensive resin, rod stock is produced in a wide assortment of sizes; diameter increments of 3 mils are available in the 1-inch-and-under range.

Integrity of rod structure and resin molecular weight are important to good quality in the machined products. Rod must be of uniform diameter, be composed of high-molecular-weight resin throughout, be free of voids (1% or less), and be thoroughly sintered. Crystallinity should be within the recommended design range of from 45 to 75 percent.

Failure to maintain these factors within the specified ranges may be disastrous. For example, doubling the crystallinity from 45 to 90% can result in a 15-fold drop in tensile and impact strengths, a 100-fold decrease in flex life, a 5-fold increase in stiffness, a 30-fold decrease in gas permeability. A rise in void content from 1 to 6% can increase permeability as much as 1000 times, while dielectric strength, tensile strength, and ultimate elongation can fall off 50 to 80 percent. High void content will also cause the rod to pick up dirt and absorb cutting oils. Such changes may mean loss of fabricator's time and material through fracture, pitting, or deformation, or failure in service.

To eliminate or reduce the possibility of such troubles, we developed a rod stock specifically for machining of critical parts. Known as TSI rod, it requires specially designed extrusion equipment which provides careful control over temperature, rates of feed and take-off, and extrusion pressure. Controlled temperature prevents depolymerization and development of brittleness on one extreme, and incomplete sintering, high crystallinity, and voids on the other. Close control over the extrusion temperature and pressure and of feed rate also has resulted in more uniform diameter and high density throughout the length of an extruded section. If the rod is out of round by as much as 5 to 10 mils, chucking will be difficult and machining wasteful, perhaps impossible. For this reason we centerless-grind our extruded rod to within ± ½ mil t.i.r., eliminating a subsequent "truing-up" pass in the screw machine, as required with un-ground rod.

Machining equipment

The basic, high-speed, metal-working machines such as lathes, screw machines, drill presses, etc., both automatically and manually-fed, are readily adaptable to the machining of TFE resin.

Of particular importance is good housekeeping. Machines and tools must be free of metal particles which could imbed in TFE and make it useless in certain electrical applications.

One of the prime considerations is the tooling that is used. High-speed cutting tools, preferably Stellite with meticulously sharp cutting edges, give the best results. Some are shown in Fig. 2, p. 125. TFE resin is not considered to be an abrasive material; but, because of its very low thermal conductivity and high heat resistance, it tends to shorten tool life by actually burning tool edges. If proper precautions are not taken, the surface in contact with the cutting tool may become so overheated through friction that the cutting edge softens. Once the edge is dulled, friction and heat generation increase, dulling the edge further and causing undesirable effects in the TFE piece. Some of the heat will be absorbed by the plastic, causing expansion, usually uneven, which in turn results in large dimensional variations.

This heat generation, together with the well-known cold flow and plastic "memory" of TFE resin tend to eat up tolerances; when they have been allowed for, the machinist must work within even closer limits.

Forming tools should generally have a 15 to 20° top rake for rapid removal of chips, and a 10 to 15° front clearance to reduce compressive forces which may tend to "push" or distort the relatively soft material. All tools should be ground to provide for "breaking" of the edges

to eliminate "hairs." Turning tools, also, should have large cutting angles. Drills, whether twist or half-round, can be effectively used in obtaining clean holes, but they must be of the polished flute type to reduce frictional heat and provide for rapid, easy chip removal. Special drills for plastics, with deep, highly-polished flutes, have been found to perform most satisfactorily, especially from the standpoint of chip removal. Half-round drills can be re-ground more readily in the tool room and provide excellent chip removal.

It should be obvious that TFE, because of its softness and cold flow, should not be subjected to undue pressure during the machining operation. Chucks should not be of a design which will leave impressions that cannot be tolerated in the finished piece. Spindles must not heat up since such heat could distort the rod stock and adversely affect machining tolerances. The amount of chucking pressure for firm holding of the piece is almost a matter of experience.

During the drilling operations, bushings are recommended for use with the standard or half-round drill to support the material and prevent its "running out." Diameter of the rod stock should be uniform so that the bushing does not squeeze the Teflon. Any pressure on the O.D. will adversely affect the finish and size of the hole.

Because of the many sources of dimensional variation in the TFE stock itself, tools must be changed and sharpened frequently. Having the tool room close to the machining area saves much time.

Personnel training

Perhaps the most important factor in machining TFE resin is the working force. From machine operator to quality-control technician, individuals with an extensive background in fine machining are essential. However, they must all undergo additional, specific training before being qualified to handle TFE resin.

Some of the points covered in the "re-training" period stress the difference between this material and all others. Personnel must understand the conditions under which TFE rod that has been stress relieved will undergo additional stress relaxation as it is being machined. If rough-machined initially, the magnitude of additional stress relaxation will be negligible when the part undergoes the finishing operation. The care and use of tools, feed rates, and an understanding of various plant controls necessary to obtain tolerances in parts being processed—from extruder to shipping room—form a part of the "re-education" to TFE.

Machining techniques

On a lathe it is desirable to work with continuous lengths of rod to minimize waste. It is, therefore, mandatory that lathes and screw machines have a free "feed-through" in the chuck. Ample room should be provided to allow the feed section of the rod to rotate freely while in the chuck, without torsion or whipping action. Small-diameter rods and long rods will require adequate support, especially during center-drilling, counter-boring, rough turning, finish turning, and even the final cut-off. Support is transferred internally, where possible, when the O.D. is being turned. The importance of support cannot be overemphasized: the limberness and softness of TFE resin, unsupported, can lead to wide variations in dimensions.

In machining TFE resin, cutting oils are required for rapid removal of frictional heat from the cutting zone. They are not required for lubrication since the resin has an extremely low coefficient of friction (0.04 on steel). Cutting oils should have high viscosities and film shear strengths because TFE resin is

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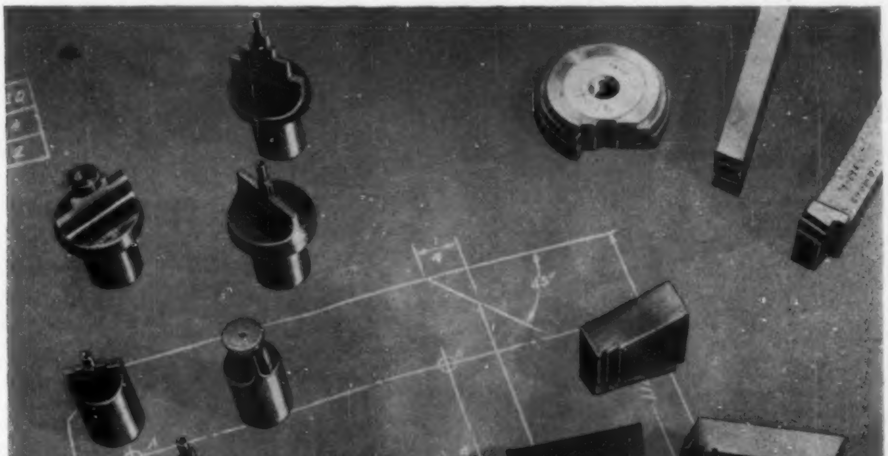
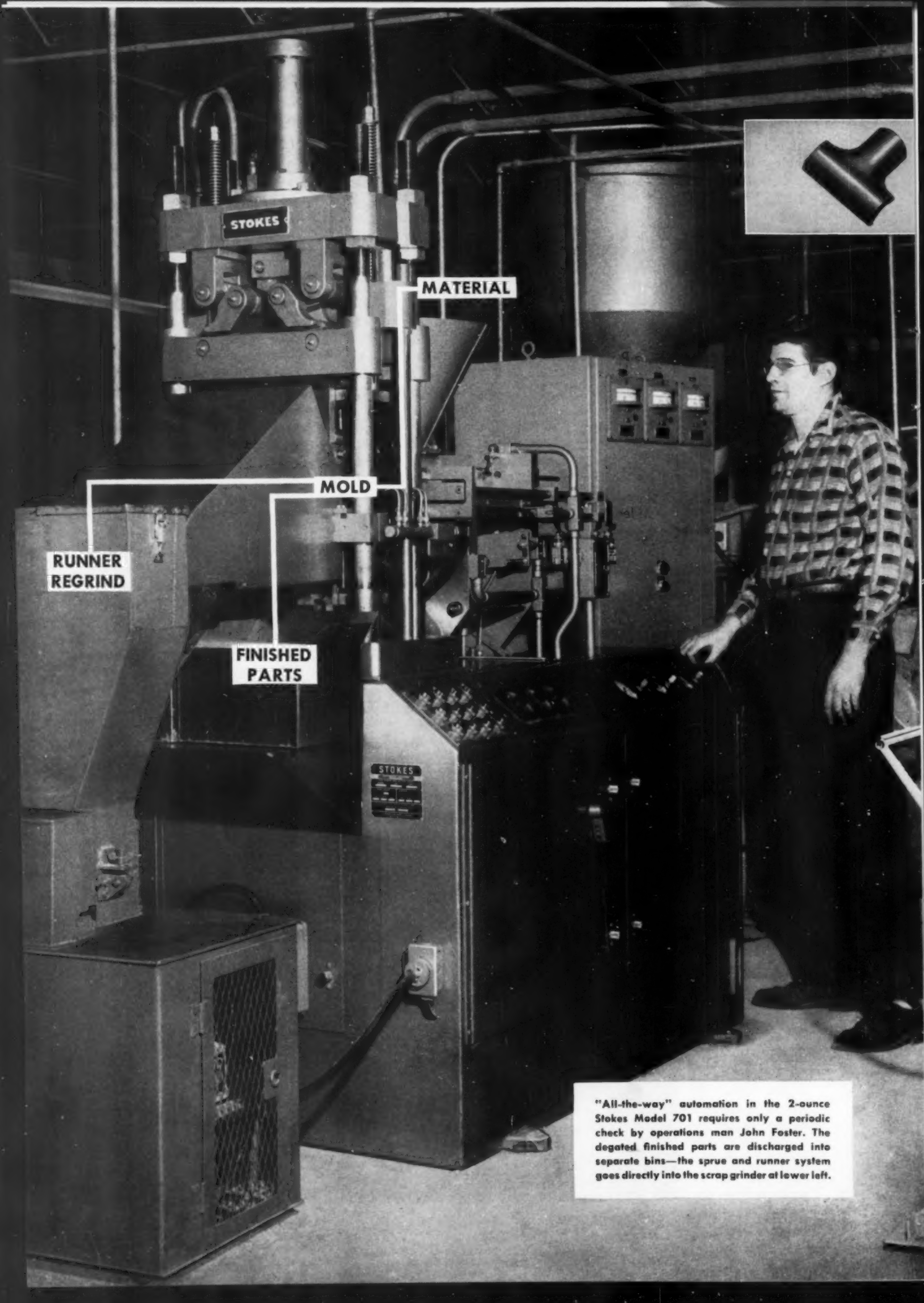
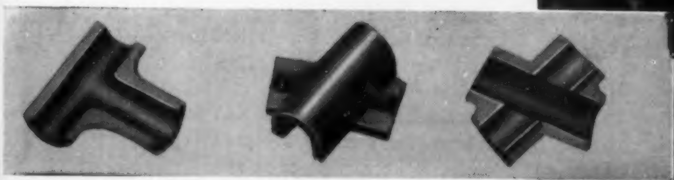
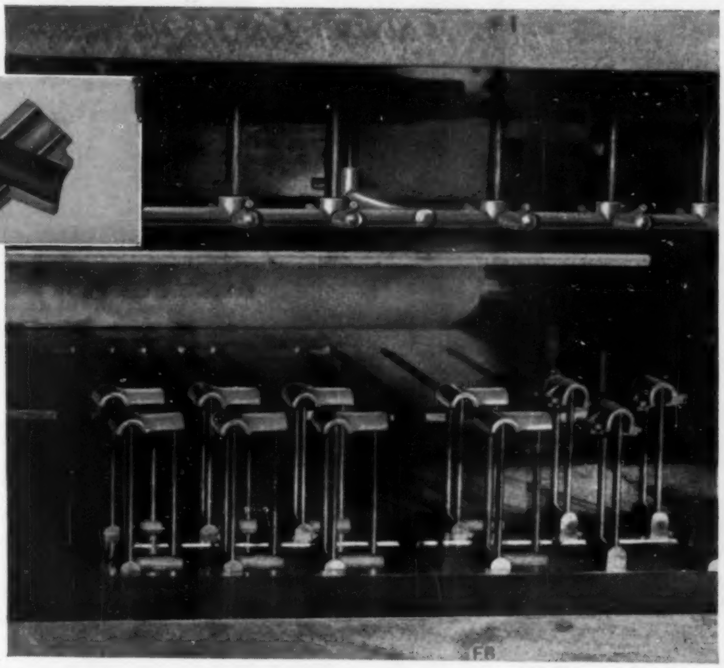
Fig. 2: Typical cutting tools used in machining TFE. (Illustrations, Tri-Point Plastics, Inc.)





"All-the-way" automation in the 2-ounce Stokes Model 701 requires only a periodic check by operations man John Foster. The degated finished parts are discharged into separate bins—the sprue and runner system goes directly into the scrap grinder at lower left.





▲ These are "Lok-links"—connecting links for the sectional fencing—made on the Stokes 701 fully automatic injection molding press.

▶ A close-up of the die area shows the degated parts and runner system on their ejector pins—ready to be stripped off by the combs. The runner and parts are delivered to separate chutes. The three different parts, at right, are automatically sorted in a divided chute.

U. S. Metal Plastics chooses Stokes 701 injection machine for "all-the-way" automation

And what is "all-the-way" automation? It's Stokes' way of saying that the 701 injection molding machines are automatic from start to finish—they take molding material and deliver finished parts, separated and sorted from the runners and sprues . . . all without operator attention. That's automatic operation 'way beyond the point where ordinary machines stop.

Heart of this "all-the-way" approach is Stokes' automatic ejection and stripping system. When the die opens, the parts stay in one half, the runner system in the other. The knockout pins stroke, then the finished parts are combed off and pushed into a delivery chute. There are no sorting problems in family dies, since different parts are pushed into different sections of the chute.

This "all-the-way" automation is why U. S. Metal Plastics, Inc., of Laurel, Maryland, chose the versatile Stokes 2-ounce Model 701 for production of all their molded parts for garden fencing, weed guns and lawn coasters.

According to Edward A. Pierce, plant engineer, the 701 provides economical high speed production of their "Lok-links", the connecting links for sectional fencing, and other parts. An existing operator, tending an extrusion line, monitors the operation of the 701—thus adding no extra labor costs.

Savings of up to 40% have resulted from this "all-the-way" automation—and, in spite of a 20-hour-day, 6-day-week schedule, only routine maintenance has been required.

Write for your copy of literature on the Stokes 701—the truly automatic 2-ounce injection molding machine. Ask for a Stokes production analysis on your own parts.

Plastics Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES

difficult to wet. The viscosity chosen depends on the ambient temperatures: in summer SAE 100 to 120 oils are used, while in winter SAE 60 to 80 oils will do. Usually, it is necessary to increase the oil reservoir capacity of a standard machine tool to permit the oil to cool sufficiently before being recycled.

Speeds

Drilling and turning operations are conducted under conditions which will assure a forward drill travel of between 5 to 6 mils per revolution when using ⅛- to $^3\!/_{16}$-in.-diameter drills. Forward travel will vary according to the thickness of the stock, with higher in-out speeds preferred for heavy sections.

With forming tools, travel along the piece has a wider variation of from 0.25 to 1 mil/rev. The variables in the use of forming tools on TFE resin are the diameter of the plastic piece and whether the operation is a roughing or finishing one. Higher speeds are used for the former, slower for the latter.

In a typical machining operation, where both surface and internal work is performed, the variables may consist of diameter of hole, length to be drilled, and rotational speed of the stock. Heating may expand the material during the drilling operation, causing a tapered hole. There are three ways to solve this problem: 1) one may perform the operation in two or more rapid, full-depth passes with a drill of the final required diameter; 2) it may be done in successive roughing and finishing passes, using an undersize drill for roughing and a drill of the correct size for the finish cut; 3) one may traverse the length of the required hole in short increments, making certain that duration of drill dwell within the piece is kept to a minimum to reduce frictional heating. If a total tolerance of 3 mils is required in a hole of 0.125 in. diameter, with a wall thickness of 0.187 in., the 3-mil tolerance must be kept 1 mil as it comes from the machine. This will allow the operator to check the expansion or contraction affecting the hole size and to make any compensation that may be necessary.

When several diameters must be formed in the same piece, it is always best to follow the roughing-finishing technique.

Special precautions

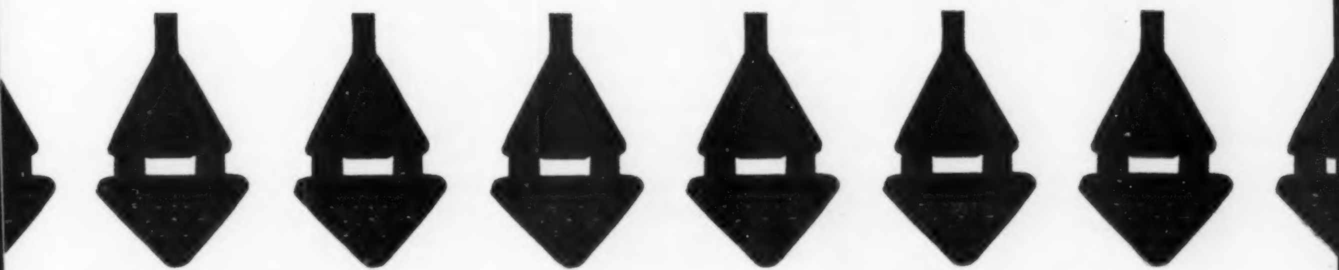
Many molders and fabricators of plastics are familiar with the phenomenon of "frozen-in" stresses. These occur during the molding or extrusion of softened plastics because the material is chilled before the high shear stresses associated with flow have had time to relax. The long polymer molecules are stretched in the direction of flow and contracted in the transverse directions. If such a piece is reheated to a temperature at which it has appreciable flow, these stresses will tend to relax, causing the piece to shrink in the flow direction and expand in the transverse directions. The same thing may occur if a substantial part of an extruded or molded piece is cut away, since the equilibrium of stresses is upset by removing material. Because TFE resin is highly viscous in the softened state yet still has some tendency to flow at room temperature, such dimensional changes are common in the machining of this material, and they must be allowed for. As an example, the large collar shown in Fig. 3, below, has two O.D.s, two I.D.s, and three length dimensions. The major O.D. was to be 1,686 ± 0.001 in., the over-all length 0.750 inch. This piece was made from extruded tubing 1.75 in. in O.D. with an 0.25-in. wall. If the collar were machined to the outside diameters given, it would be found that within a few minutes after the machinist finished the outside cuts, those diameters would have changed by from 3 to 5 mils, throwing the piece well outside the tolerance limits. The machinist, from previous experience with pieces of similar dimensions, knows this will happen and makes his cuts accordingly.

Thin-walled sections may either expand or shrink, depending on the type of tool used, and the type of cut made, so tools are made several thousandths over- or undersize, as the case requires.

In *thick* sections, a different change occurs. Contrary to a popular misconception in TFE machining circles, when a rod of substantial diameter has been drilled dead center, the material does not shrink, but expands! The reason for this is that center drilling removes the restraining core, permitting stress relaxation. This results in expansion in the

Fig. 3: Teflon pieces with multiple diameters, such as those shown in photo below, require special machining techniques to obtain close tolerances

New shaker top of **TENITE POLYETHYLENE** sells more salt for Morton



A simple packaging improvement that lets a housewife *sprinkle* salt right from the container has given Morton Salt Company an important sales lead in market after market.

The new patented shaker device, fitted into the top of the salt package, consists of sprinkler and self-hinged sprinkler-cover, molded all in one piece. The material is Tenite Polyethylene in a formulation which affords just the right stiffness to keep the cover erect when open, and ample toughness to guard against breaks in the hinges.

The desired blue color is achieved by using a Tenite Polyethylene color concentrate, added in fixed proportion during the molding process. By this means, Morton secures uniform color results while employing several different molders.

In Tenite Polyethylene, the Morton Salt Company also found the more general characteristics needed to make the idea practical. First of these were low material cost and ease of fabrication. Important, too, were resistance to corrosion by salt or water; moldability that would permit one-piece design; and resilience that would make possible a tight friction-fit between cover and sprinkler.

The shaker top is a good example of how the many useful properties of versatile Tenite Polyethylene can satisfy design needs. If you have a design—or even just an idea—that could be given effective reality in polyethylene, why not look into the possibilities offered by Eastman's wide range of formulations.

For more information on Tenite Polyethylene and advice about its use, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Shaker top molded for Morton Salt Company, Chicago 3, Ill.,
by: Korris Products, Inc., Lyons, Ill.
Victory Manufacturing Co., Chicago 12, Ill.
Northwest Molded Products Corp., Skokie, Ill.
Ken Hagen Co., Shelburn, Ind.
Federal Tool Corp., Chicago 45, Ill.

TENITE
POLYETHYLENE
an Eastman plastic

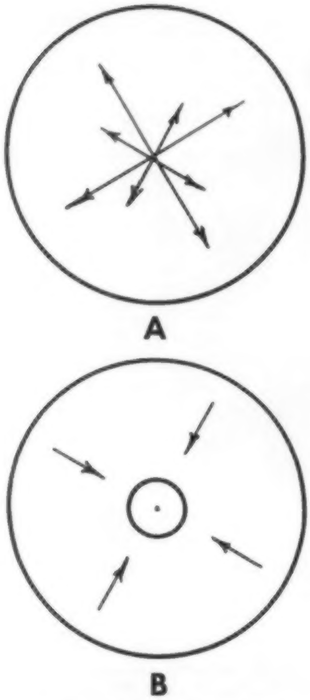


Fig. 4: Diagram A shows radial stresses in extruded rod prior to machining. One would expect dead-center drilling to allow stress-relaxation with some expansion of material. As diagram B illustrates, when rod is center-drilled, stress relaxation actually produces contraction

radial direction and shrinkage in the lengthwise, extrusion direction. Thus, the O.D. becomes larger, the I.D. smaller, and the length smaller. This is shown schematically in Fig. 4, above.

Unusual trends in contraction and expansion may also be due to incomplete sintering and/or improper stress-relief of rod stock. Stresses are eliminated in TFE resin in two ways: by application of heat or by machining. Stresses are never set up in the plastic by machining which has been properly planned.

As mentioned previously, tool heating or excessive cutting rates should be avoided at all costs if reasonably close tolerances are to be expected in the finished piece. Heating is especially troublesome in I.D. work where removal of frictional heat by cutting oils is more difficult. As seen in Fig. 5, below, frictional heat retained on the wall of the hole results in lateral, surface expansion of material, increasing the size of the cavity. Less material is subsequently removed by the drill, making the final hole undersize or tapered. If the condition is recognized, then additional passes are required to correct it. This may not be a simple matter, especially where compound diameters are generated simultaneously in the same piece, and it must then proceed to secondary operations in the shop. Re-chucking and re-drilling may compound the tolerance variations.

The piece shown in Fig. 6, p. 132, rather large by machined-TFE standards, serves to illustrate these problems in expansion and contraction that arise when there are wide differences in material thickness in the same piece. If this dished piece were machined from TFE by the techniques employed for common plastics and other materials, the dished or concave surface would tend to get more and more concave, and the flat surface assume a convex form. The cause is found in stress relaxation at different rates from the center out because of differences in thickness.

Secondary operations

Secondary operations, such as drilling and cut-off are usually carried out on machined pieces after a normalizing or stabilizing period of up to several days at room temperature, or by annealing for 1 to 24 hr. in an oven at temperatures in the range 350 to 500° F., the exact time depending on the item and temperature. During the normalizing period pieces should be protected against contamination by dust and other foreign matter.

Final inspection

After completion of necessary machining, parts are cleaned with cutting-oil detergent and lukewarm (not hot) water and dried prior to inspection.

Inspection tools and techniques must also be adapted to suit the characteristics of TFE resin. Micrometers and gages ordinarily considered accurate and proper for checking other machined materials are not adequate for TFE. Likewise, checking or inspection techniques employed for other materials must be "unlearned" and modified techniques "learned" for the inspection of machined TFE resin. The "feel" of the material is particularly important and can be acquired only through experience.

In inspection of I.D.s, plug gages rather than I.D. micrometers must be used because of the deformability of the plastic even under slight pressure. Even with solid rod, the inspector must exercise a soft "feel" and not a heavy hand in the adjustment of

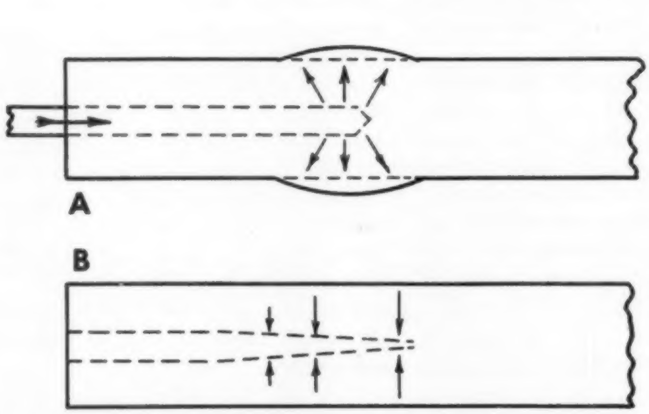


Fig. 5: Diagram A illustrates condition which exists when drilling holes deeper than ⅜ in. in rod stock, or when the drill is not perfectly sharp or without correct cutting edge angle. Frictional heat gives rise to excessive localized expansion of material and too-rapid stress relaxation, causing material to draw away from drill. Subsequent cooling results in tapered hole (diagram B). Proper tool control and drill speeds help solve the problem

the micrometer. Otherwise, errors as large as 10 mils may result.

On thin-wall pieces, O.D.s are measured with the I.D. supported from within by a gage of the appropriate size to prevent even a minute bending inward of the walls. *In checking I.D.s with plug gages, the dimension is calculated on the basis of the number of ounces of pressure required to introduce the gage.*

Standard procedures can be established in the checking of most parts which are machined. On occasion, the inspection technician must contrive new and sometimes Rube Goldberg-ish appliances which will allow him to get the true picture of the tolerance of a finished part.

Quality control

Quality control used in machining parts from TFE resin is in some respects similar to that used in other materials, but overall control has been specifically developed to answer the needs and peculiarities of this material. An important difference between TFE and most other materials that are machined is the former's high cost. The incentive to reduce waste is great enough to warrant a rather thorough quality control program.

At Tri-Point, when a print for a part to be machined from TFE resin is received, we first decide whether it can be made by available techniques, tools, and screw machines. The required machining operations are analyzed to ascertain whether the *specific* tolerances, form, and finish required by the part in question can be achieved consistently and economically. Past experience on similar parts is very helpful.

A pilot run on a hand screw machine is then made to prove out the forming tools and the machining techniques and sequence to be used later on the automatic screw machine. Before the pilot run, all of the tools, machine cams, and accessories are inspected carefully by the tool room, previously indoctrinated to Teflon plastic characteristics. Forming tools are given particular attention as to tolerances. Among the instruments used are several instruments specially adapted to working with TFE resin. In tool inspections, tolerances are checked to within at least half a mil, and with many measurements, to a quarter of a mil. Particular attention is given to cutting- and rake-edge angles and sharpness. When pilot runs have given the desired results, automatic operation is started.

Control of material quality, discussed at the beginning of this

Fig. 6: Large aircraft antenna insulator, 5½ by ⅞ in., illustrates unusual stress relaxation Teflon can undergo during machining. Starting with base machined to proper flatness, inexperience in generating concave face would give rise to bowing of base and the face becoming more concave. Both flat and concave faces must be machined using sequences that will compensate for these stress-relaxation characteristics of TFE resin

article, is extremely important. Contamination of rod stock with scrap can be dangerous, and can cause serious deficiencies in electrical and mechanical properties. Machining characteristics may also be changed and may become more irregular. Where best control of dimensions and properties in service is desired, only stock extruded from 100% virgin material should be used.

Quality control starts in our extruding department where each batch of rod produced is tested for the following: void content, hardness, completeness of sintering or consolidation, and foreign matter inclusion. Unless the results fall within the rigid standards established for the material, the rod is rejected and never reaches the automatic screw machine.

Quality control, however, cannot test or determine the degree of stress of rod at the source, even if the machining plant produces its own rod. The stress-relieving characteristics of the material can be evaluated for the particular part according to the machining set up. This is determined initially at the hand screw machine, then again on the automatic screw machine. Likewise, the automatic screw-machine operator is trained to be particularly cautious in the first three groups of 10 parts, testing dimensions and surface finish of each part.

If, out of the first 10 parts produced, the operator finds one or two parts "out," he runs another 10 parts and checks all produced to that time. If, at the end of the second batch of 10 parts, he finds two or more "out" to that time, and an obvious fault is not the cause, the operation is shut down and an immediate conference with tool room, quality control, and engineering staffs is held. Often the entire set up is broken down and "re-worked"—speeds, machining sequence, and forming. Corrections in machining sequence and adjustments of tool dimensions to counteract any unexpected stress relieving phenomenon may have to be made. Corrections in tool dimension may be as little as a quarter of a mil in some cases.

Quality control's chief strategy is to prevent trouble by eliminating as many potential trouble sources as possible before machining starts. For example, the fact that ambient temperatures may have a marked effect on the machining characteristics of Teflon must be kept in mind.

Quality control is particularly important at the screw machine and is the responsibility of each person who has anything to do with the machine. In the metal

(*To page* 232)

Automatic resin content control

in high-pressure laminate manufacture

*By Herbert R. Levine**

Laminate properties are sharply dependent on the resin content of the laminates, which is subject to many sources of variation. By controlling squeeze-roll pressure, all prior sources of variation can be compensated for. This has led to much more uniform properties in the finished laminates and has cut scrap by 40 percent. Squeeze-roll pressure is controlled by adjusting roll gap, using the differential signal from two beta-ray gages as criterion for adjustment. The gages measure sheet areal density before and after impregnation. Details of the control system are given.

Reliability and uniformity of the properties of laminated plastics products are to their users prime and continuing considerations.

To achieve control over fabricating operations and dependability in service requires uniformity in such properties as:

1) Punchability
2) Machinability
3) Moisture absorption
4) Flexural strength
5) Impact strength
6) Dielectric strength
7) Uniformity of thickness
8) Dimensional stability
9) Appearance

These properties are to a very significant degree dependent on uniformity of the resin content of the laminate. Accurate, rapid, and continuous control of resin content is a requisite for achieving uniformity and reliability in the product properties just listed.

In General Electric Co.'s Laminated Products plant, Coshocton, Ohio, a system of gages, computers, and controllers provides this kind of resin-content control. As a result more uniform material is now being produced, and the amount of material which falls outside the specification limits has been reduced by 40 percent. Improved materials utilization and the reduced rejection rate have enabled the automatic control equipment to earn its development, construction, and installation costs in less than one year.

*Development Engineer, Laminated Products Dept., General Electric Co., Coshocton, Ohio

Impregnation

The procedure for making thermosetting plastics laminates requires that cloth or paper material be impregnated with resin, cut into sheets, stacked, and pressed at elevated temperatures and pressures. Each of these steps is important, but if the sheet material is not impregnated properly to start with, the finished laminates' properties generally suffer.

In the Coshocton, Ohio, plant this impregnation is accomplished by unwinding the sheet material from a roll and passing it through a tank of resin solution (see Fig. 1, p. 134). It then passes between a pair of heavy precision-ground "squeeze" rolls, one of which can be raised or lowered. It is at this point that the resin content of the impregnated material is controlled, since increasing the gap between the squeeze rolls increases the resin content. From this point the impregnated stock enters a long oven (75 ft. or more) where solvent is driven off and the degree of cure of the resin advanced. When it emerges, the impregnated material is either rolled up or cut into sheets immediately. The treating machine impregnates either a single roll of two rolls up to a total width of 100 in. run side by side.

Since operating a treating machine involves far more than only adjusting the squeeze rolls, the operator must spend a large portion of his time away from them. During the course of a single treating run under manual control, the machine operator makes many 200-ft. round trips to his squeeze roll adjustment screws. For truly efficient control, the number of trips can reach the unrealistic (for manual control) figure of 15 control actions per hour where treating speeds are in excess of 100 ft./min. The factors which make these repeated adjustments of the squeeze rolls necessary during the course of a run include:

1) *Differences in untreated weight between one raw material roll and the next.* These can be relatively large and may require relatively drastic squeeze roll adjustment.

2) *Differences in raw weight which occur within a roll.* These are relatively small, but they can still be large enough to throw resin content beyond their specified levels.

3) *Variations in the absorbency of the raw sheet.* These generally occur between rolls of raw material. Their effect can be large enough to cause the resin content to be outside the predetermined tolerance limits.

4) *Differences in solids content of the impregnating varnish.* These can result from solvent evaporation, from differences in resin solutions when more than one batch is used within a given treater run, and from the settling out of components which are dispersed but not dissolved. These

changes are large enough to cause the resin contents to drift beyond specified limits.

5) *Changes in treater speed.* Since these change the period of time which the paper spends in the dip tank, they can definitely have a significant effect on resin pickup.

Measurement of resin content

A beta-ray-gage system, installed some time ago, measures the areal densities, or mass per unit area, of the raw and impregnated materials. Two such gages are used on each treater. One gage, located just before the resin dip tank, measures the density of the raw material. The other, situated just beyond the exit end of the oven, measures the areal density of the treated material. The gage heads move together from edge to edge of the webs, pausing to measure and then moving on. When two webs run side by side, all four edges are gaged.

The gages' locations on the treating machine are shown in Fig. 2, p. 135. For each edge a report is made of the raw and treated weights on a two-pen recorder. These weight signals are transmitted to an analog computer, which subtracts the raw from the treated weight and divides the difference by the treated weight. The quotient, expressed as a percentage, is the resin content of the treated material. This quantity is reported on a single-pen recorder and is the basis on which resin content control actions are made by the operator. In normal operation, this alone would keep the operator so busy that he would probably not have time for his other assigned duties.

Experience with the beta-ray gages has demonstrated that, if optimum and uniform resin content is to be obtained, control actions should be made far more frequently than the operator can make them. An automatic controller which operates on the basis of the beta-gage-ratio-computer's reports, and which can make control actions with the frequency required, is described here.

Control principles

Most of the properties of a laminate vary with resin content, some very critically. Some properties suffer and others are improved as the resin content is changed. Often a very delicate balance in properties is achieved by the control of resin content alone. In some laminates this means that any variation in resin content which does occur must be in one direction only. This is analogous, in machining practice, to tolerance of -0.000, $+0.001$ inch. Thus, we have two different situations which must be handled. In one, resin contents must be at the target or may safely be permitted to vary slightly *below* it only. In the other, resin contents must be at the target or may safely be permitted to vary *above* it only.

These two situations establish the principle upon which the controller design is based. Added requirements are that the controller never requires the squeeze rolls to dig into each other (by calling for an impossible negative gap), that an alarm be sounded and control action be halted if an excessively large correction is called for, and that no control actions be possible when the beta-ray gages are sent off the sheet to facilitate threading the machine, or when they momentarily stop measuring to permit automatic standardization for the correction of circuit drift, radioactive source decay, and thermal drift.

Consider now the operations in impregnating a single web of material. The beta-ray-gage system reports the resin content at each edge of the web to the controller which decides the direction and size of the control action and then changes the position of either or both ends of the adjustable

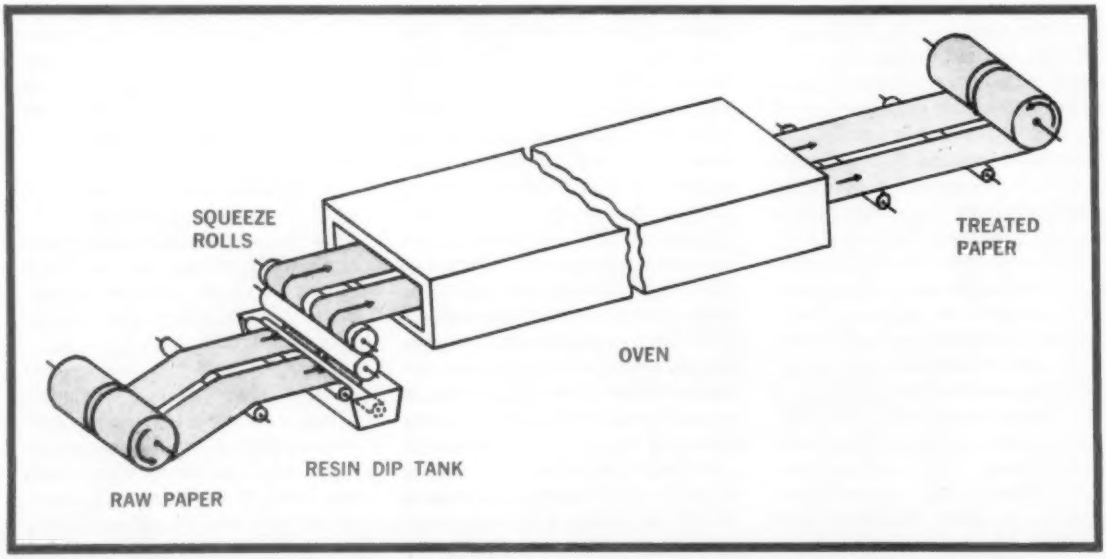


Fig. 1: First step in development of automatic resin-content control system: the basic impregnation system

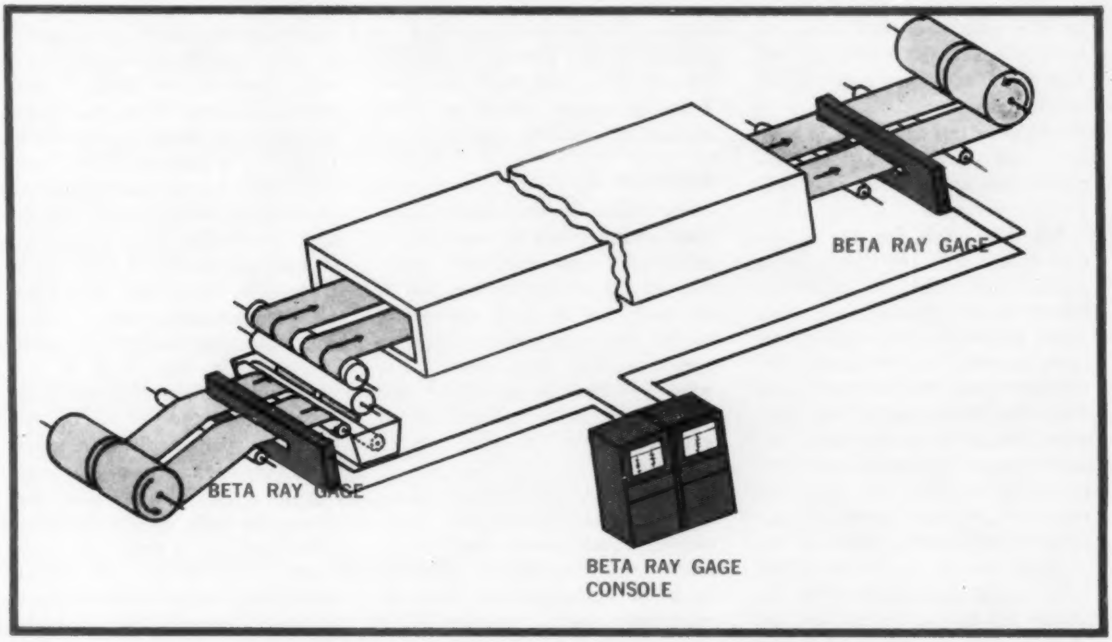


Fig. 2: Second step involves incorporation of measuring device: beta-ray gages are added

squeeze roll to make the necessary compensation.

While this is going on, a number of lights are flashing to indicate where and in what direction a control action is being made. Shortly thereafter a corresponding shift in the indication of the resin content chart appears. At the squeeze-roll end of the treating machine, the motor and gear box assembly mounted on each of the two squeeze-roll adjustment screws operate momentarily as they adjust the squeeze-roll gap. Figure 3, p. 136, shows their location.

Control equipment

The equipment required to accomplish this close control is a combination of radioactive, electrical, electronic, and mechanical components. Strontium-90 is used by the beta-ray gages as an electron source. These gages are the sensing organs of the system. The gages' resin-content computer reports its results to a servo-balancing recorder in which a motor operates to balance out the resin-content signal from the computer by positioning a variable resistor attached to its motor shaft. In so doing, the motor also positions the chart pen. Another variable resistor, which is supplied with a steady voltage from the controller's power supply, is also attached to the recorder pen motor's shaft. This potentiometer's output varies as the resistance is changed when the recorder's balancing motor changes position. This occurs when the resin content changes and is, therefore, analogous to the resin-content report.

Meanwhile, an independent reference voltage has been established by pre-setting a "set point" potentiometer. This signal is compared with the one sent over from the computer recorder to produce a difference which constitutes an error voltage. When the beta-ray-gage measuring period for the paper edge involved is completed (in the case where a single web is being impregnated), this error signal, with transient peaks filtered out, is processed and sent to a polarized relay. The relay actuates the opening or closing of the squeeze-roll adjustment motor for the side involved. The sign, plus or minus, of the error signal determines the direction in which the relay is thrown and whether the control action is an opening or a closing of the gap. The larger the error voltage, the larger the control action.

This is accomplished by inserting the error signal into a servo loop. Part of this loop is a differential potentiometer whose wiper is driven by the squeeze-roll positioning motor. With the error signal present in the loop, the roll-positioning motor must rotate the potentiometer arm until the error signal is balanced out. Of course, while the motor is doing this, it is also adjusting the squeeze roll by turning the squeeze-roll positioning screw. When the error signal is balanced out, it is removed from the circuit. This leaves the servo loop unbalanced again, but the squeeze-roll positioning motor is not permitted to do anything about rebalancing. Instead, another motor rotates the barrel of the differential potentiometer until the loop is rebalanced. In this manner, the system is re-zeroed each time a control action is taken. By basing each new control action on the last position, rather than on some absolute position, positioning errors are kept to a minimum.

Meanwhile, having measured the first edge of the web, the beta-ray gages have gone on to the next edge and started their measurement. A separate servo loop for the control motor on this side of the squeeze roll is actuated

by the results of this measurement when it reaches completion. The actual sequence calls for one servo loop to adjust its side of the squeeze roll while on the other side the beta-ray gages are measuring and the other servo is being re-zeroed.

All this holds for the simple case where only one web is being treated and only two edges are being gaged. When two webs (and, therefore, four edges) are being treated, a little more is involved. Here, the error signal from the first edge of the first web is held in storage until the error signal for the second edge is available. Then the two are compared. By setting the appropriate switch earlier, we have instructed the controller to either bring resin contents to, but not below the target, or to, but not above the target. Then either the lower or the higher of the two readings becomes the basis for the ensuing control action for that side of the squeeze roll. The gages and the controller then attend to the other web and the other side of the squeeze roll. After that the cycle is repeated. The length of the measuring and control cycle is 3 to 12 min., varying inversely with the speed at which the treating machine is operating. The period is adjusted by changing the time that the beta-ray gages dwell at each measuring station.

Backlash

Backlash in the squeeze-roll positioning gears is capable of producing very significant position errors, and provision had to be made for it. Such expedients as the use of precision gears, or spring-loading the gear train, were rejected because they are sensitive to wear, or subject to clogging from dripping resin solution, or because they would remove the treater from production for an excessively long period. Such mechanical solutions were avoided by building backlash compensation into the electronic control system. This was achieved by having every control action, whether opening or closing, end in the closing direction, just as is done in changing a lathe setting. Thus, when a closing action is called for, the motor drives in the closing direction only. But when an error signal whose sign calls for an open action is developed, it causes a proportional relay to insert into the circuit an additional error signal which corresponds in sign to an open action and in magnitude to the backlash correction desired. When the excessively large opening action thus called for is completed, the backlash error signal is switched out, leaving an unbalance in the circuit. The drive motor then closes to again restore the null condition, thus completing the backlash-compensated open action. The time required for the entire sequence is less than 5 sec., a period small enough to make insignificant the effect on the treated paper of the excessively open condition. Manually changing the setting of a potentiometer alters the size of the backlash compensation signal over the range 0° to 90° of lost motion. Half-yearly minor re-setting is all that is necessary to adjust for gear wear.

Versatility

Adjustable elements other than the backlash compensation are provided to give the controller the versatility which a multiproduct treating machine demands. One of these is an adjustable deadband, which determines the amount by which

(To page 231)

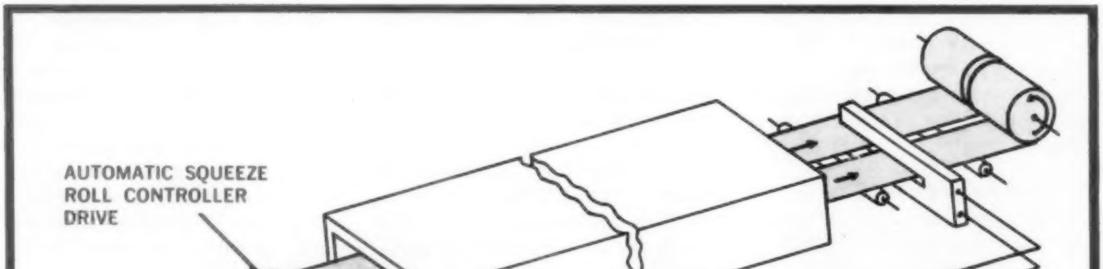


Fig. 3: Final step: automatic squeeze roll controller is added, completing automatic resin content control system

Extrusion and forming

of high-density polyethylene blown tubing

*By Robert Doyle**

Extrusion of high-density blown tubing in the thicknesses from 1 to 20 mils requires close attention to operating conditions, which are given here. Slit tubing, either in continuous or sheet form, may be thermoformed into a variety of useful objects, particularly packages. Recommendations are made for forming high-quality products. Tables are given showing the variations in strength properties of blown tubing with sheet thickness and blow-up ratio, and the dependence of cycle times on sheet thickness.

High-density polyethylene, with its rigidity, chemical inertness, toughness, and translucency, is an interesting packaging material. Packages—and many other useful items—can be made by extruding the molding powder as blown tubing in the usual way, then slitting the tubing to make sheeting, and forming the final products from the sheet. It is the purpose of this article to describe the processing equipment, techniques, and conditions that have given good results in extrusion of blown sheeting and in forming articles from such sheeting.

Extrusion

For the experimental extrusion of blown tubing for thermoforming, a standard 2.5-in. extruder of L/D = 20 was used. The extruder was equipped with a conventional, stepless-type, polyethylene metering screw that has a 4:1 compression ratio. The die was a stock 4-in., blown-tubing die, with a 0.020-in. die lip opening. The air ring was made locally because no suitable air rings were found to be commercially available. Following the most common American practice, the tubing was extruded vertically upwards. The "tower" was a standard, commercially available unit with a center-wind type of dual wind-up and automatic tension control for both winding stations. A photograph of the complete set-up in operation is shown in Figure 1, p. 140.

Preliminary trials quickly demonstrated that the stiffness and the low coefficient of friction of high-density polyethylene film were factors which must be reckoned with for successful extrusion and film handling. Problems with wrinkling and winding hampered these early efforts but these problems were eventually resolved. Specifically, it was discovered that, for various reasons, the following design and operating details deserved special consideration:

1) Initial start-up should be made with a *clean* die and the die must not be "burnt" in starting up. A full die may be started up thereafter if proper attention is given to protecting the die from "burning" in any further shutdowns or start-ups. This procedure eliminates "lines" in the film that are prone to cause wrinkles in this stiffer material.

2) All equipment should be accurately leveled and aligned. The

(*To page* 140)

Fruits in trays thermoformed from polyethylene blown tubing, ready for covering, sealing, and freezing. (Details on the production and forming of such tubing are given in the accompanying article.) Since contents of trays will show through transparent film covers, there is no need for any color photographs on package to identify the product

*Sales Service Laboratory, Phillips Chemical Co., Bartlesville, Okla.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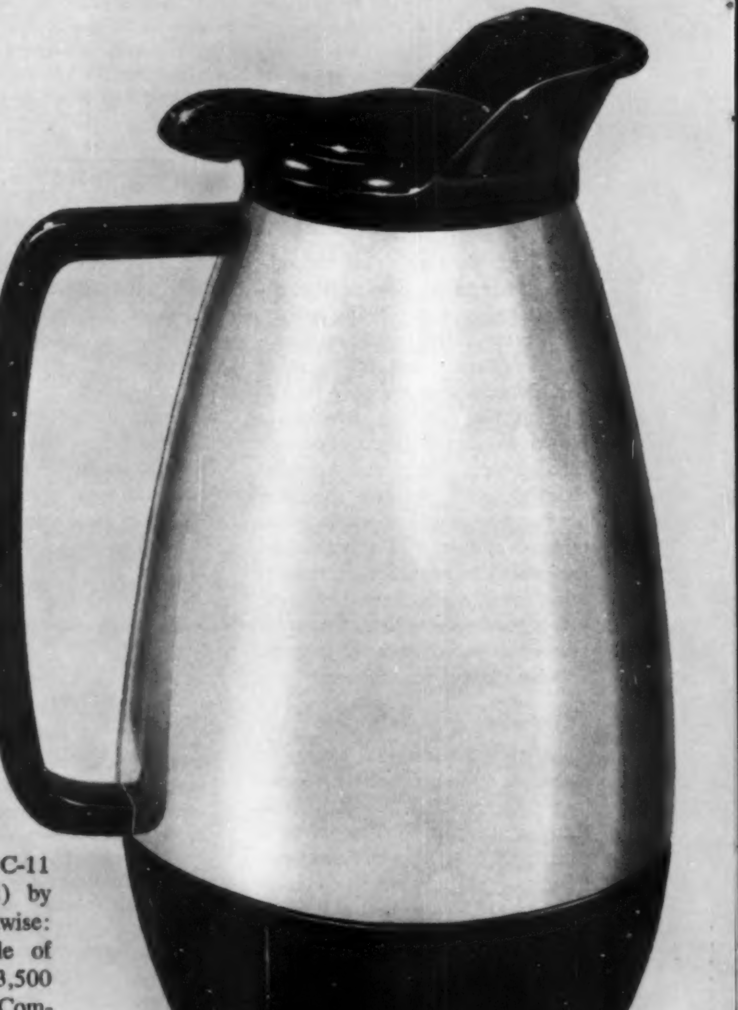

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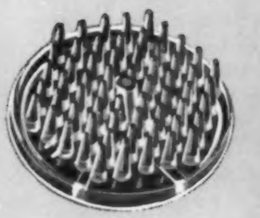

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TABLE OF PROPERTIES (RMD-4511)

Values Relating to Fabrication	
Specific Gravity (D792-50)	1.07 (Varies slightly with color)
Weight per Cubic Inch (Molded) gms.	17.5
Bulk Factor (D1182-54) Diced	1.98
Pellet	1.71
Molding Shrinkage (D955-51), in./in.	0.004
Values from Mechanical Tests	
Izod Impact Strength (D256-54T) ft.-lb./in. of notch	
⅛ in. thick	0.55
¼ in. thick	0.45
Tensile Strength (D638-52T), psi	12,000
Elongation in Tension (D638-52T), per cent	3.2
Flexural Strength (D790-49T), psi	17,300
Modulus of Elasticity in Flexure (D790-49T); psi	5.2×10^5
Values from Miscellaneous Tests	
Heat Distortion Temp. (D648-45T) (¼ in. thick, 264 psi) deg. F.	200
Thermal Coefficient of Linear Expansion (D696-44) per deg. C.	7×10^{-5}
Water Absorption (D570-54T), per cent gain in weight in 24 hours	0.23
Rockwell Hardness (D785-51)	M83

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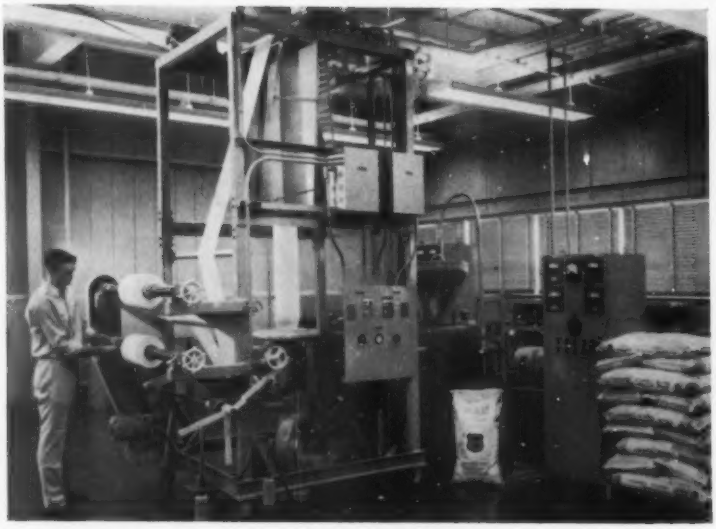

Fig. 1: Small production-scale blown tubing unit. Air ring used was homemade. (Photos, Phillips Chemical Co.)

high stiffness of this material necessarily makes alignment more critical.

3) Good thickness control must be maintained. With 1-mil film, caliper variation can be kept to ±0.1 mil; within these limits wrinkles can be eliminated. For good control of caliper, the following three factors should be given close attention:

(a) Die must be adjustable and be properly adjusted (positioned).

(b) The ring must provide an accurately uniform flow of air. The air ring used in this development work gave a ±2% variation in air velocities around the inner circle and no adjustment or rotation was required.

(c) Total air flow should be easily controllable since, with a good air supply, air flow must generally be throttled.

4) Die and extrusion conditions should be selected to eliminate a visible weld line in the tubing on the side of the die opposite to where the material enters from the extruder. This weld line is a point of weakness in the tubing and it shows up as an objectionable flaw in vacuum formed items (see Table I, right).

5) The "frost line," i.e., the point of maximum blow-up of the bubble, should be kept as close to the die as possible with proper selection of temperatures and with adequate cooling.

6) The bubble must be shielded from even the slightest drafts or other air currents which might cause variations.

7) High linear speeds of the tubing facilitate most film-forming and handling processes. Where extruder capacities limit the production of heavy-gauge tubing, linear speeds may be too slow for satisfactory tube formation.

8) Flattening of the bubble must be gradual and gentle in action because of the stiffness of the tubing. A long approach, with a small included angle between two flat perforated metal sheets, has given best results to date. In contrast, a series of a half dozen or so pairs of small idler rolls in the pinch roll approach of another installation has never been as satisfactory.

9) Pinch roll pressures should be controllable and the minimum practical pressures consistent with maintaining sizes should be employed. Otherwise, severe weakening of the edge creases may result.

10) Center winding is the only type of winding which can be recommended. The very low coefficient of friction of high-density polyethylene tubing would become an advantage on bag-making equipment but it must be expected that this same property will generally render any surface-winding type of equipment at the extruder quite unsatisfactory.

It is believed that the first nine factors listed above represent no more than good practices in the

Table I: Extrusion conditions for high-density polyethylene blown tubing

Indicated motor load, kw.-a.c.	0.5-4.25
Screw speed, r.p.m.	22-72
Hopper water, °F.	
In	80
Out	82
Cylinder, °F.	
Rear	290-320
Zone 2	290-330
Zone 3	300-340
Front	310-350
Die, °F.	310-350
Stock temperature, °F.	315-360
Developed screw pressure, p.s.i.	2200-3400
Screen pack, no. and mesh	20/80/20
Linear speed, ft./min.	8-95
Output, lb./hr.	Up to 90
Range of sizes	
Thickness, mils	1-20
Width, in.	6-30

Notes: 1) "Neutral" screw used throughout in the above. 2) Vertical distance, die face to pinch roll nip: 90 inches.

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Table II: Variation of properties of high-density polyethylene blown tubing with increasing thickness at one (1:1) blow-up ratio

Nominal thickness	Tensile strength MD[a]	Tensile strength TD[b]	Elongation MD	Elongation TD	D1004-49T Tear strength MD	D1004-49T Tear strength TD
mils	p.s.i.	p.s.i.	%	%	g./mil	g./mil
1	4690	2150	230	5	328	558
2	3480	2150	247	7	440	526
4	3780	3060	289	13	352	452
6	4130	3010	486	34	374	459
8	4150	4470	60	17	397	440
10	4210	4190	35	17	380	455
12	4290	4370	27	20	360	449
14	4290	4330	24	19	361	431
16	4390	4180	27	19	385	404
20	4340	3670	24	17	360	396

[a]MD=machine direction. [b]TD=transverse direction, as extruded.

extrusion of polyethylene blown tubing. But with a higher-density polyethylene, attention to these factors is *demanded* rather than merely indicated. Regarding the need for center-winding as opposed to surface winding, this might be thought of as a special requirement. However, many "high-slip" polyethylene compounds containing anti-blocking agents may impose a similar requirement. On the favorable side, it should be pointed out that because high-density polyethylene is essentially non-blocking in nature, higher operating speeds, less cooling, and/or less pinch-roll heights are possible than with lower-density materials. Since extruder outputs are about the same with polyethylenes of all densities and since practical production speeds have previously been limited mainly by film cooling rates, it is clear that operating costs should be lower in producing the high-density film.

Utilizing only the single die and the other equipment described in the introduction to this section, and with due recognition given to the 10 factors itemized above, blown tubing of excellent quality, from 6 to 30 in. in width as wound, and from 1 to 20 mils in thickness, has been produced from high-density resin. Not all widths were produced at all thicknesses but only because of the limitations imposed by die dimensions, extruder speed, and the linear speed of the blown tubing. For optimum results in these runs, operating conditions were held within the range of conditions given in Table I, p. 140. Even within this range, it was usually found desirable to extrude the heavier gages at lower temperatures and the lighter gages at somewhat higher temperatures within the range indicated. Some test data illustrating the properties to be expected from film produced under the conditions shown in Table I are given in Tables II, above, and III, below. The effect of thickness upon properties for one blow-up ratio is given in Table III. In general, a ratio from 2 to 3 yields the best balance of properties and facilitates film extrusion.

In preparing the samples mentioned above, it was noted that the strength of the creases along each edge of the blown tubing decreased markedly under some conditions, at least in the heavier gages. While not important where the material was to be slit for subsequent thermoforming, it was, nevertheless, a factor to be considered in applications where the blown tubing was to be used as such. Hence, the conditions affecting the strength of the crease were explored and it was found that minimum nip roll pressures (see #9 above) and minimum stock temperatures at the die favored maximum crease strength.

Slitting

The high-density polyethylene blown tubing, extruded as described above, may be utilized directly for many packaging applications. However, for vacuum forming and other applications where it is necessary to start with a single thickness of material, the next step, of course, is slitting.

The slitting of high-density polyethylene film (10 mils and under in thickness) or sheeting (over 10 mils) presents no special problems. Actually, since this film is not "stretchy," tension control is no real problem and good slitting is generally accomplished with considerable ease. Score cutting and razor blade slitting have been employed with excellent results and it would appear that any slitter capable of handling cellophane, cellulose acetate, or con-

Table III: Variation of properties of high-density polyethylene blown tubing with increasing blow-up ratios at one (2 mil) thickness

Blow-up ratio tubing diam./ die diameter	(ASTM D 882-56T) Tensile strength MD	(ASTM D 882-56T) Tensile strength TD	(ASTM D 882-56T) Elongation MD	(ASTM D 882-56T) Elongation TD	(D 1004-49T) Tear strength MD	(D 1004-49T) Tear strength TD
	p.s.i.	p.s.i.	%	%	g./mil	g./mil
1/1	3480	2150	247	7	440	526
2/1	3640	2780	324	208	387	452
3/1	3980	3490	323	210	379	435
4/1	3590	3270	438	301	316	346
5/1	3040	2750	234	299	349	344

Note: MD=machine direction. TD=transverse direction, as extruded.

ventional polyethylene films could handle high-density polyethylene film of the equivalent thickness with equal success.

Thermoforming

Single-thickness film or sheeting in continuous rolls or cut sheets (whichever is suitable for the forming equipment available) can be thermoformed by a number of techniques. However, in the equipment which has been employed to date, the following conditions appeared to give the best results for all thicknesses of high-density polyethylene blown tubing:

1) High-density material in the melt-index range of 0.8 to 1.0 (Marlex 50, Type 9) has thus far yielded the most satisfactory blown tubing for thermoforming.

2) The sheet forming machine should be equipped with integral heaters. The older machines, where the sheet is pre-heated in an oven remote from the forming machine, are generally unsatisfactory because of the abruptness of softening of this highly crystalline material.

3) The actual sheet temperature at the time of forming; which is never measured directly in production should be in the range of 350 to 400° F.

4) Allowance should be made in setting up the machine for some sag of the sheet during heating. The sharp softening point generally makes it impractical to control the film or sheeting, during extrusion, to the precise degree of orientation required for perfect "snap back." In fact, if the material has been too highly oriented during extrusion, it may tear as it softens and shrinks. Thus, only a moderate degree of orientation is preferred although no reason has been found, where standard vacuum forming equipment is employed, for insisting on a completely isotropic sheet.

5) Molds should preferably be of machined or cast aluminum, cored for water cooling. If cast, the castings must be free of any voids or surface pitting.

6) Production molds should be thermally controlled by a separate, circulating-water type of mold temperature control unit. For maximum uniformity and minimum post-forming warpage, water temperatures in the range of 160 to 210° F. are generally optimum.

7) Mold polishing is usually not required or even desirable. The surface having maximum gloss will be on the side of the formed item *opposite* to that which contacted the mold, in any case. A fine, uniform matte finish on the mold, such as that obtained by a light caustic etch, will generally facilitate forming, probably because it reduces adhesion of the hot sheet to the mold.

8) The vacuum holes in the mold should be as small as possible. Since linear polyethylene film or sheet takes exceptionally fine detail, it will also be pulled into any of the larger vacuum holes. Holes made with a #80 (0.0135 in.) drill are recommended. To pull the sheet down rapidly onto all parts of the mold requires enough holes—from 100/sq. ft. for a large flat area to perhaps 600/sq. ft. for an intricately contoured area.

9) For maximum surface gloss on the formed items and for minimum production cycles, the formed sheet should be surface chilled, as with a blast of air from an air hose, as soon as the sheet contacts all parts of the mold while the vacuum is "On."

Some examples of the production cycles obtainable for thicknesses up to 20 mils in one particular mold are given in Table IV, below. These data show an almost constant increase of 1 sec. of heating time per 2 mils increase in original thickness. It should also be pointed out that the mold, in this case, was not water-cooled because this series of runs was strictly experimental and hence of short duration. However, the cycles given do represent the time required to produce a maximum quality item.

Table IV: Effect of thickness upon thermoforming cycles

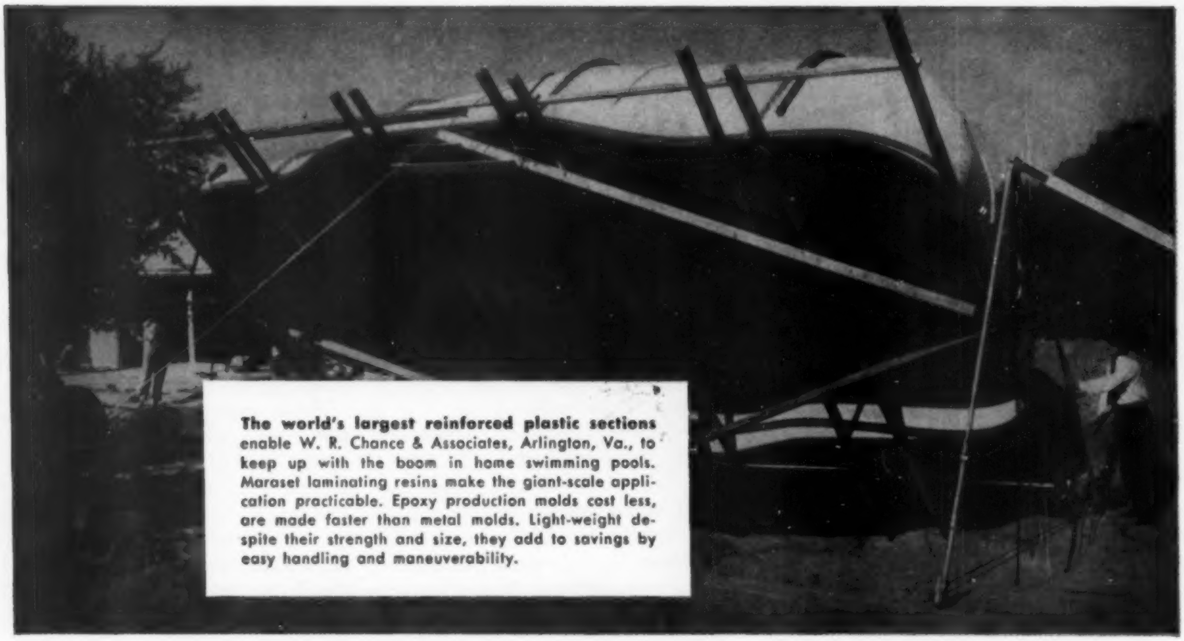
Film or sheet gage (mils)	*Time*		
	Heating	*Forming*	*Total*
	sec.	sec.	sec.
4	7	10	17
6	9	10	19
8	10	10	20
10	11	10	21
12	12	10	22
14	13	10	23
16	14	10	24
20	16	10	26

Heater capacity: 3.26 kw./sq. ft. Heater rod temperature: 1100 F. Distance, heater rods to sheet: 4½ in. Mold: aluminum, air-cooled externally. Material: blown tubing from Marlex 50 polyethylene, Type 9.

Applications

Techniques have been discussed for the extrusion, slitting and thermoforming of high-density polyethylene blown tubing. Possibilities for packaging and other types of applications with this material appear to be almost limitless because of its chemical inertness, toughness, low permeability, high stiffness, ability to withstand hospital sterilization and temperatures down to −180° F., and its potentially low cost and good formability.

Some of the suggested possibilities are: frozen food cartons (heat sealed over with printed polyethylene film), skin packs for complete food items such as fish filets, disposable cups and food serving trays or tray liners for roadside eating places, sterilizable dispensers for hospital and institutional use, party hats and novelties, interchangeable tote tray liners for a variety of light weight products, protective shields for many uses including the protection of fragile goods in transit, molds for the mass production of slow curing products, light diffusers and many others.



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Polyesters of dimer acids as intermediates for urethane foams

By R. D. Aylesworth,[†] R. H. Boehringer,[†] D. T. Moore,[†] and M. H. Smith[†]

Methods of polyester and flexible foam preparation are presented for a urethane system that is based on polyesters of dimer acids. Optimum dimer acid polyester foams simulate foamed rubber in all important respects but afford greater versatility, lower densities, "in situ" foaming potential, and excellent adhesion to various surfaces. Dimer acid polyester is significantly less costly than adipic acid polyester. Raw material and processing costs of the dimer acid polyester system and the polyether-TDI adduct system are approximately equivalent. Success of any one of the three competing urethane flexible foam systems will depend largely on foam density, adaptability to commercial foaming, and ability to meet the peculiar technical requirements of specific applications.

For many years, articles prepared from foamed rubber have been useful items of commerce for applications where gradual and recoverable deformation under light compressive loads has been the main characteristic sought. It has been estimated that production of foamed rubber in the United States reached a total of 175 million lb. in 1954, 6% of the total usage of new rubber in the same period (1,2)[1].

Despite this wide usage, it cannot be claimed that foamed rubber is a completely satisfactory material. Among its deficiencies are the following: it is rather readily degraded by oxidation; it loses considerable strength when wet; it is difficult to prepare in very low densities (3).

In view of both the popularity and deficiencies of foamed rubber, it is natural that extensive efforts have been made to find other systems that exhibit superior properties or lower cost. References are in the literature to foams made not only from natural or synthetic rubbers, but also from polystyrene, cellulose acetate, vinyl resins, phenolic resins, urea resins, and others.

One system that has aroused great interest in the United States during the past several years comprises the polymers derivable from reactions between polyesters or polyethers and diisocyanates—the "urethanes." They offer these advantages: 1) the foams are readily prepared in a wide variety of densities; 2) hardness may be varied from extremely flexible to very rigid; 3) the compositions may be foamed in place to fill irregularly shaped spaces; and 4) the foams exhibit excellent adhesion to a wide variety of surfaces.

There is considerable basis for the belief that flexible urethane foams will replace a substantial portion of the existing market for foamed rubber. Furthermore, ample evidence has been accumulated during a relatively short period of commercial exploitation to conclude that flexible urethane foams are capturing markets that have not been successfully invaded by foamed rubber because of technical or cost limitations.

The objectives of this paper are to present the details of laboratory methods by which low-density, flexible foams may be prepared from dimerized fatty acids; to demonstrate that flexible foams based on dimerized fatty acids exhibit many of the characteristics required in flexible foams for the major commercial applications; to compare foams based on polyesters of dimer acids with two alternative systems proposed as intermediates for flexible urethanes and with foamed rubber; finally, to compare the economics of the three competing urethane systems. In

*Reg. U. S. Pat. Off.
†Emery Industries, Inc. The authors wish to express appreciation to J. D. Farr, Development and Service Dept., Emery Industries, Inc., for his interest and helpful suggestions. This paper was presented in part before the Div. of Paint, Plastics and Printing Ink Chemistry of the American Chemical Society, 131st National Meeting, Miami, Fla., April 7-12, 1957.
[1]Numbers in parentheses link to references at end of article, p. 154.

Table I: Typical examples of dimer acid polyesters for flexible foams

Components		Mol ratio		% by weight
		POLYESTER A (Flexible)		
Dimer acids (Emery 3065-S)		1.0		78.6
Diethylene glycol		1.5		21.4
	Acid value		1.8	
	Hydroxyl value		74	
	Viscosity (25° C.), cp.		13,000	
		POLYESTER B (Flexible)		
Dimer acids		1.0		81.0
Diethylene glycol		1.2		17.4
Trimethylolethane		0.1		1.6
	Acid value		2.4	
	Hydroxyl value		65	
	Viscosity (25° C.), cp.		28,000	

the last analysis, the product meeting minimum performance requirements at lowest cost will ultimately claim the predominant share of the market.

Polyesters of dimer acids

Polymerized fatty acids derived from unsaturated fatty acids by a reaction usually referred to as a "dimerization" (4) are generally known to the chemical industry as "dimer acids"; this designation will be used throughout the remainder of this paper. The products have been articles of commerce for a number of years, and some discussion of characteristics and uses has been published (5). As used in this work, dimer acids consist essentially of a mixture of C_{36} dibasic and C_{54} tribasic acids, in a molar ratio of approximately 5 to 1, with average molecular weight of about 650 and equivalent weight of just under 300. The product is a viscous liquid of color 10 to 11 (Gardner).

The preferred method for preparing the polyesters (Table I, above) follows one of two slightly different paths, depending on whether or not a triol is included in the formula.

When a triol is not used, the acid and glycol are heated together under total reflux for 1 hr. at 150 to 160° C. Water of esterification is thereafter removed continuously while the temperature gradually rises to 210 to 220° C. When most of the water has been removed, a vacuum of 20 in. is drawn on the system and heating continued at 230° C. for 4 to 5 hr., or until the desired acid number is reached.

When a triol is to be used in addition to the glycol, the esterification is carried out in two stages. The procedure outlined above is followed until the acid number is about 25. At this point, the triol is added, and the batch heated for 1 hr. more before vacuum is drawn on the system. The finish of the operation is then the same. It is important to note that the use of silicone stopcock grease may inhibit subsequent foaming.

Foam formulation variables

Converting the polyesters into foams is an art, rather than a science. In addition to the polyester, three other components are necessary: 1) a diisocyanate; 2) water; 3) a catalyst. Additionally, emulsifiers or "stabilizers" may be present.

There are a number of isocyanates in commercial use at the present time, all aromatic and all difunctional, of which the most common is tolylene diisocyanate. The amount used is generally close to 100% of that theoretically required to react with the polyester and the water. A decrease in the amount of isocyanate in the formulation tends to give foams of higher density; an increase may lead to poor structure, with the occurrence of cavities.

Since the amount of water used determines the volume of gas liberated, the water content is another important factor in controlling foam density. With one particular polyester system for medium-density foams, incremental increases in water content from 1 to 2.7% (by weight, based on polyester) caused a progressive decrease in density from 6.3 to 3.1 lb./ft.[3] In another system, for low-density foam, increase in water content from 2.6 to 3.7% lowered the density from 1.75 to 1.35 lb./ft.[3] However, excessive amounts of water may lead to postfoaming shrinkage in adipate polyester systems. A report on the addition of various amounts of water to an isocyanate-glycol adduct (emulsifier and catalyst held constant) shows shrinkage from 0% at 25 mole percent water addition to 15 to 20% at 90 mole percent (6).

The catalysts generally used are various tertiary amines. A number of such amines were studied (6) and a qualitative summary of the results shows:

Dimethylaniline	Inhibition
Quinoline, pyridine	No effect
Triamines (ethyl, propyl, amyl)	Extremely rapid
N-Methyl and N-ethyl morpholine	Moderately rapid

A number of amines have been investigated as catalysts for dimer acid foam systems. One particularly versatile catalyst is triethylene-diamine [1,4-diazabicyclo-(2·2·2)-octane] which is available as Dabco from the Houdry Process Co. Dabco was used as a catalyst for the major portion of the dimer acid polyester foams reported in this paper. Two addi-

Table II: Formulations for two flexible urethane foams based on polyesters of dimer acids

Components	Foam 1 parts by wt.	Foam 2 parts by wt.
Polyester A	1,000	
Polyester B		1,000
N-ethyl morpholine		67
Dabco	6.7	
Water	26.5	16.7
Tolylene diisocyanate (TDI)[a]	386	267
Foam density	1.75	4.0

[a]Hylene TM, E.I. du Pont de Nemours & Co., Inc.

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tional tertiary amines, stearyl dimethylamine (Armour & Co.) and N,N-diethylcyclohexylamine (E. I. du Pont de Nemours & Co., Inc.) have shown some promise although approximately five times the level of either of the latter two is required to equal the catalytic effect of Dabco.

Foam formulations also often include an emulsifier, or a mixture of emulsifiers. Several score such materials have been investigated in this laboratory, most of them having shown little or no promise. Among the ones that have shown at least somewhat favorable results have been: glyceryl monooleate; sorbitan monostearate; and lecithin. Additionally, some heavy metal soaps have led to foams of very good structure and density, but with very poor resistance to hydrolysis.

Many other compounds of comparable molecular weights, solubilities, and/or ionic strengths have been of no use at all. There seems, therefore, at the present time, to be no rhyme or reason in the choice of an emulsifier, or in the amount to be used.

Foam preparation

There are two methods of foam preparation in common use. They are frequently referred to as the "one-shot" method and the "prepolymer" method, respectively.

The one-shot method is basically a single operation. All of the components except the isocyanate are mixed together (depending on the formulation, the order of mixing may or may not be important), the isocyanate is then hurriedly mixed in, and the foaming mixture poured into a mold.

In the prepolymer method the isocyanate is first reacted with all, or part, of the polyester to form an adduct that is relatively stable to prolonged storage. When the adduct is then mixed with the other components the foaming reaction occurs.

In either case, the foam may be removed from the mold after 20 to 30 min. and final curing may be carried out in an oven (70° C., overnight, is sufficient) or at room temperature for 1 wk. or more.

Formulation data for two flexible urethane foams are given in Table II, p. 146. The one-shot method is used throughout.

Data in Table III, below, and IV, p. 150, demonstrate the effect of independently varying tolylene diisocyanate and water in a dimer acid polyester foam system in which Dabco was used throughout as a catalyst. The quantity of Dabco used in all of the examples listed in Tables II, III and IV was 6.7 parts by weight (p.b.w.)/1000 p.b.w. polyester. Variation of Dabco from 5.7 to 7.7 p.b.w./1000 p.b.w. polyester resulted in no significant difference in characteristics of a typical foam of approximately 1.8-lb./ft.^{3} density.

Foams from adipic acid polyesters

Early work in the urethane field was devoted almost exclusively to systems based on adipic acid polyesters. Until comparatively recently, such systems were universally characterized by three major deficiencies: 1) considerable and rapid deterioration in physical properties upon exposure to humid conditions; 2) rapid change in color (from white to various shades of brown) on aging; 3) load-compression response sometimes referred to as a "snow-crust effect," that is, good support for small loads, followed by a range within which very small increases in load produce large increases in compression (Fig. 1, p. 152).

More recently, increased know-how in formulating, preparing, and manipulating these systems

Table III: Influence of variation in TDI on characteristics of flexible urethane foams based on polyester A

Foam number	1	2	3	4	5	6
Polyester	1000	1000	1000	1000	1000	1000
Water	26.5	26.5	26.5	26.5	26.5	26.5
Dabco	6.7	6.7	6.7	6.7	6.7	6.7
TDI (Hylene TM)	309	346	386	424	443	463
% theoretical TDI	80	90	100	110	115	120
Density, lb./ft.^{3}	2.0	1.8	1.75	1.7	1.9	1.9
Hardness	8	13	25	40	45	53
Resilience, %	40	41	43	43	44	42
Compression set,[a] %	9.9	10.7	7.2	7.1	7.9	9.6
Tensile, p.s.i.	16.7	16.8	17.6	19.6	20.1	11.3
Modulus, p.s.i.	6.8	7.3	8.8	10.8	12.3	10.0
Elongation, %	300	280	220	190	170	130
After SPI hydrolytic aging[b]						
Hardness	11	26	33	44	58	69
Compression set, %	7.7	9.9	14.6	11.7	15.5	20.2
Tensile, p.s.i.	13.8	13.9	15.5	16.3	14.5	13.6
Modulus, p.s.i.	5.6	6.4	8.6	11.0	12.5	11.9
Elongation, %	260	240	185	150	135	125
After hydrolytic aging in live steam, 24 hr.[c]						
Compression set, %	8.7	16.2	10.5	22.5	22.8	25.3
Tensile, p.s.i.	12.6	9.8	14.7	13.2	14.6	13.5
Modulus, p.s.i.	6.2	3.5	7.4	7.2	12.6	9.5
Elongation, %	260	270	230	200	130	165

[a]Compression set is defined as % compression based on original height.
[b]Society of Plastics Industry test method, 3 hr. at 220° F. (2.5 p.s.i. steam pressure.)
[c]A test devised at Emery Industries.

Table IV: Influence of variation in water on characteristics of flexible urethane foams based on polyester A

Foam number	*1*	*2*	*3*	*4*	*5*
Polyester	1000	1000	1000	1000	1000
Water	20	26.5	30	33.3	36.7
Dabco	6.7	6.7	6.7	6.7	6.7
TDI (Hylene TM)[a]	320	386	418	450	484
Density, lb./ft.^{3}	2.38	1.75	1.59	1.43	1.36
Hardness	37	25	20	23	23
Compression set, %	6.5	7.2	10.4	9.5	11.4
Tensile, p.s.i.	19.4	17.6	18.7	17.8	18.4
Modulus, p.s.i.	7.8	8.8	9.4	10.7	11.3
Elongation, %	245	220	210	170	170
After SPI hydrolytic aging					
Hardness	33	33	35	38	34
Compression set, %	15.1	14.6	23.2	25.1	15.7
Tensile, p.s.i.	12.1	15.5	11.8	17.8	15.4
Modulus, p.s.i.	5.9	8.6	5.5	9.6	9.0
Elongation, %	225	185	205	180	175
After hydrolytic aging in live steam, 24 hr.					
Compression set, %	—	10.5	19.7	18.6	25.1
Tensile, p.s.i.	12.7	14.7	15.3	17.2	16.2
Modulus, p.s.i.	6.9	7.4	7.9	10.0	10.0
Elongation, %	215	230	205	210	190

[a]All foams contain 100% theoretical TDI

has resulted in considerable improvement in the products. It is fair to say that, at the present time, the best of the adipic polyester foams are no longer as seriously deficient with respect to either of the first two of the above objections. However, the third continues to be a serious hurdle.

Foams from polyethers

Various hydroxyl-terminated polyethers have been investigated as urethane foam intermediates. Recently, polyoxypropylene glycols of approximately 2000 molecular weight have gained a significant commercial status as raw materials for flexible urethane foams (7). Unfortunately, there is a scarcity of published information regarding methods of preparation for the polyether foams. Detailed data are available relative to the properties of polyether-based isocyanate foams (8,9); see Fig. 2, p. 152.

Performance data for four commercial polyether foams are presented in Table V, p. 152. Two improved adipate polyester foams, foamed rubber, and two typical dimer acid polyester foams are included for comparison.

The various properties of foams may be assigned degrees of importance dependent on the end-use in view and, to some extent, foam formulations may be varied to obtain the best performance with respect to some chosen property. Economic considerations dictate the use of the foam of the lowest density that will meet the other requirements of any intended application, and the success of any proposed system in competitive markets will depend, in part, on the ability to produce low-density foams.

Polymerized acid polyester systems can be formulated to give a wide variety of foam densities, and strength and compression characteristics are well retained even at densities below 2 lb./ft.^{3} (Fig. 3, p. 152). Tables III and IV show some representative examples of the results that can be obtained.

Hysteresis effect

Also of importance is the ability of a foam to recover its original dimensions when a load is removed. In Fig. 4, this hysteresis effect is plotted for the 2.4- and 1.8-lb./ft.^{3} foams from Fig. 3, the unloading having been carried out in the same manner and at the same rate as was the original loading. Similar curves for foamed rubber (5.75 lb./ft.^{3}) and for a polyether foam (2.5 lb./ft.^{3}) are shown in Fig. 5, p. 154.

Also of interest in respect to recovery from an applied load are the "compression set" figures in Tables III and IV. In this test, the sample is compressed to one-half of its original thickness and held for 22 hr. at 70° C. After removal of the load, the percent loss of sample thickness is determined after a recovery period ranging from 30 to 40 min. at room temperature.

Rebound is likewise associated with the ability to recover from an applied stress. It is determined as the height to which a ball, or other non-pointed object, will bounce when dropped onto a foam slab of appreciable thickness and is expressed as a percentage of the height from which the object was dropped.

Retention of physical properties after extended service in a hot, humid environment is important in many of the proposed applications for flexible foams. Several methods have been suggested for predicting resistance of foams to hydrolytic degradation. Probably the most satisfactory is checking physical properties of foams that have been held at 70° C. in an atmosphere approaching 100% relative humidity. Considerable use has been made in our laboratories of a test involving the measurement of physical characteristics of foam samples that have been exposed to saturated steam at 100° C. for 24 hr. followed by drying the foam samples at 70° C. for 3 hr. and conditioning at 25° C. and 70% relative humidity for 24 hr. A proposed SPI (Society of Plastics Industry) humidity test consists of exposing the foam at 220° F. for 3 hr. This test has little to recommend it. It is generally accepted that the more exaggerated and telescoped a predictive test of this type becomes, the less likely there will be agreement with actual service conditions. Furthermore, the advantage of relatively short exposure time of the proposed SPI test is largely defeated because of the consideration that foam samples must certainly be properly dried and conditioned following humidity exposure in order to make possible the achievement of reproducible results.

Data for foams that have been exposed to both the 3-hr. SPI

Table V: Performance data for two typical dimer acid polyester foams, four commercial polyether foams, two improved adipate foams, and foam rubber

						After 24 hr. live steam				After SPI hydrolytic aging			
Foam type	*Density*	*Comp. set*	*Modulus*	*Tensile*	*Elong.*	*Comp. set*	*Modulus*	*Tensile*	*Elong.*	*Comp. set*	*Modulus*	*Tensile*	*Elong.*
	lb./ft.^{3}	%	p.s.i.	p.s.i.	%	%	p.s.i.	p.s.i.	%	%	p.s.i.	p.s.i.	%
Dimer acid polyester	2.1	9.1	10.5	19.3	200	—	—	—	—	7.9	10.0	19.0	195
Dimer acid polyester	1.75	7.2	8.8	17.6	220	10.5	7.4	14.7	230	14.6	8.6	15.5	185
Polyether A	2.5	8.2	3.8	15.5	337	5.7	3.2	14.6	300	8.0	3.3	17.5	545
Polyether B	2.0	13.3	5.0	7.2	200	12.6	0	0	87	—	—	—	—
Polyether C	2.0	18.4	3.0	10.1	312	11.1	3.0	7.5	275	12.6	2.6	10.5	330
Polyether D	2.6	3.8	5.5	6.4	140	4.7	4.0	5.1	137	—	—	—	—
Adipate A	2.4	10.5	9.5	15.2	175	—	1.0	1.0	100	—	—	—	—
Adipate B	1.86	9.1	7.0	15.3	260	25.3	4.9	15.4	490	—	—	—	—
Foam rubber	5.75	8.7	4	8.2	240	4.7	4.5	6.5	150	—	—	—	—

test and the 24-hr. humidity aging are presented in Tables II, III, and IV.

Dimer acid polyester vs. rubber foams

Since the public is accustomed to foamed rubber, it is pertinent, for many applications, to analyze the properties of other foams from the viewpoint of their similarity, or lack of similarity, to this "standard."

Dimer acid polyester foams approach this desideratum at least as closely as does any other of the competitive systems. The resistance to degradation by heat and moisture, the comparative absence of a "plateau" in the load-compression curve, the good recovery when a load is removed, and the retention of good physical properties at very low densities are all points which one, or more, of the other foam types does not equal (Fig. 6, p. 154).

Additionally, there are several respects in which dimer acid polyester foams are superior to, or more versatile than, foamed rubber. 1) Dimer acid polyester foams are more readily prepared in a wide range of densities and degrees of rigidity or flexibility than is the case with foamed rubber. 2) Dimer acid polyester foams are less susceptible to oxidation than foamed rubber; on long-term aging they should be significantly superior. 3) Dimer acid polyester foams may be readily foamed in place to fill irregular or hard-to-reach spaces and, during foaming, exhibit excellent adhesion to a wide variety of surfaces.

Economic comparison

To attempt other than a preliminary examination of economics of the three competing urethane systems is beyond the scope of this paper. However, several conclusions are warranted and additional factors that are important with respect to relative economics can be roughly spelled out.

Following are the current prices for the major components of the three flexible urethane foam systems:

Dimer acids	26.5¢
Adipic acid	32.25¢
Polyethers	23.0¢

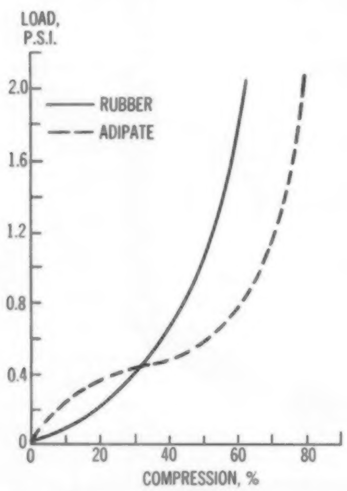

Fig. 1: Typical load-compression curves for foamed rubber and a urethane foam based on adipic acid polyester. Densities (lb./cu. ft.): rubber—5.7, adipate—2.8

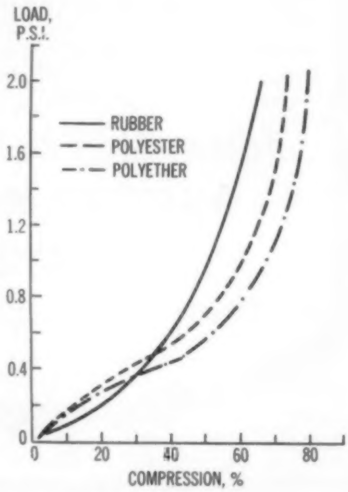

Fig. 2: Typical load-compression curves for foamed rubber and for urethane foams based on a polymerized fatty acid polyester and on a polyether. Densities (lb./cu. ft.): rubber—5.7, polyester—2.4, polyether—2.5

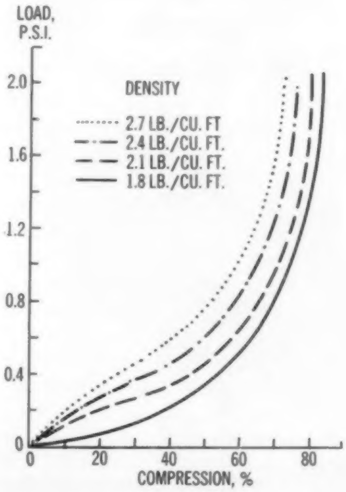

Fig. 3: Load-compression characteristics of polymerized acid polyester urethane foams as a function of the foam density

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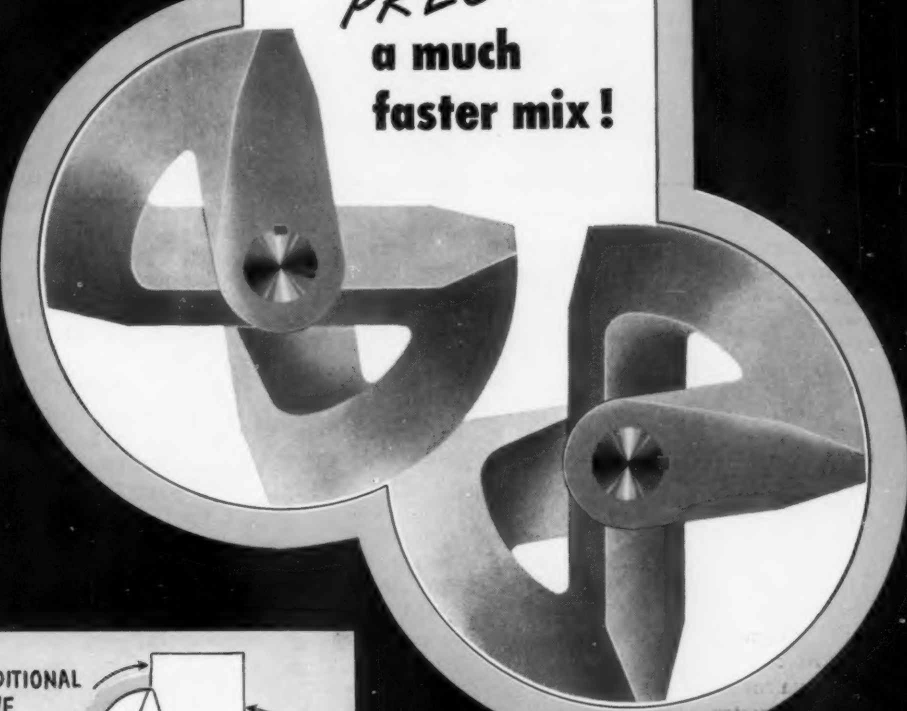

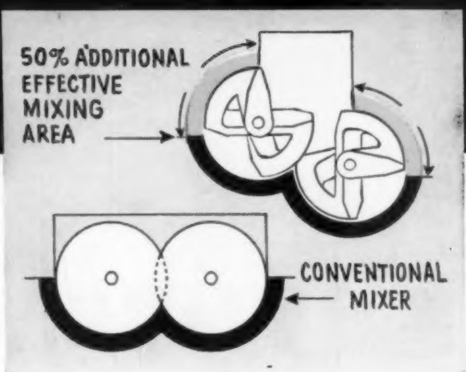

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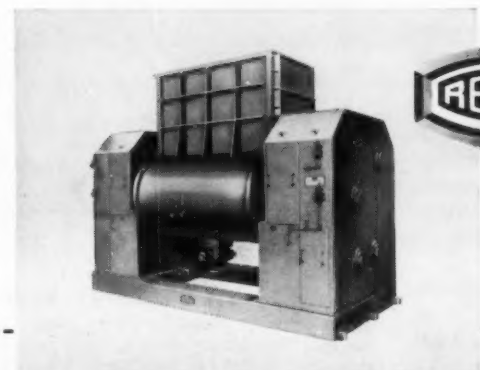

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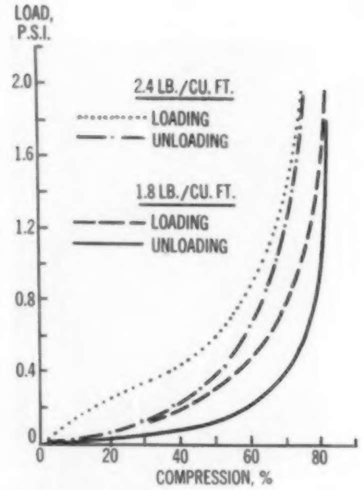

Fig. 4: "Hysteresis" curves for two polymerized acid polyester urethane foams; short-time recovery after removal of stress

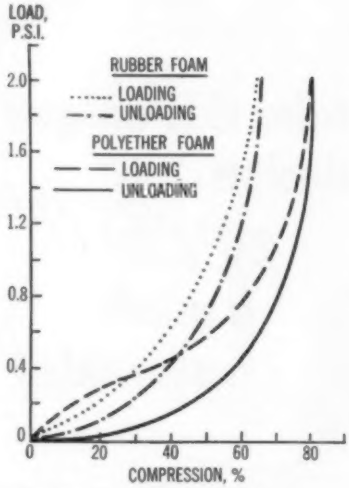

Fig. 5: "Hysteresis" curves for foamed rubber and polyether urethane foam. Densities (lb./cu. ft.): rubber—5.7, polyether—2.5

Diethylene glycol[2]	17.75¢
Tolylene diisocyanate	95.0¢

Each of the three systems requires one processing step preliminary to foam preparation. Both dimer acids and adipic acid are converted to polyesters. Polyethers are adducted with TDI before commercially practicable foam can be prepared.

Assuming equivalent polyol cost, dimer acid polyesters are substantially lower in cost than adipic acid polyesters. Three factors are involved in comparing the two polyester foam intermediates: 1) cost of the acids; 2) yield of polyester; and 3) processing cost. The initial cost advantage of dimer acids is further extended in terms of polyester yield by reason of the relatively large loss of water during esterification of adipic acid. Loss of water in a typical dimer acid polyester for flexible foams is less than 5% of the weight of acid and polyol charged to the esterification kettle. Processing equipment for preparation of polyesters is essentially the same for both acids. However, based on commercial experience with esterification of both dimer acids and adipic acid it is concluded that suitable dimer acid polyester can be prepared at a significantly lower processing cost than adipic acid polyester.

[2]Diethylene glycol is only one of a number of polyols that may be suited as polyester intermediates. However, this specific glycol has been widely used and the assumption that DEG is generally applicable to urethane systems appears to be completely justified.

The cost of preparing an appropriate TDI adduct of polyethers is difficult to assess completely. There should be no loss in weight in preparing the adduct. Processing equipment similiar to the type used for esterification is required. To those who have worked with reacting tolylene diisocyanate and polyethers or polyesters in the laboratory there are two questions that are of paramount importance when plant manufacture is contemplated. 1) Does the adduct reaction result in consistent, reproducible products from one production lot to succeeding lots? 2) If an error is made in production procedures, is the product recoverable?

Economics of the adipate polyester system prior to foaming are significantly disadvantageous when compared to the two other systems. There is very little to choose between the dimer acid system and the polyether system prior to foaming from the viewpoint of raw material and processing costs.

To attempt to evaluate the relative cost of foaming the three alternate flexible urethane foam systems would be pure speculation. Foams made from each of the three intermediates will very probably satisfy specific market requirements. It is certainly reasonable to conclude that competition for major markets will be resolved largely by one or both of the following: 1) adaptability to commercial foaming of consistent, reproducible, high-quality flexible foam with minimum scrap and off-quality product; 2) attainment of minimum density with retention of desired physical properties.

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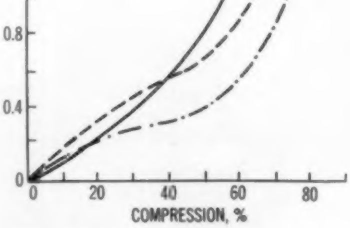
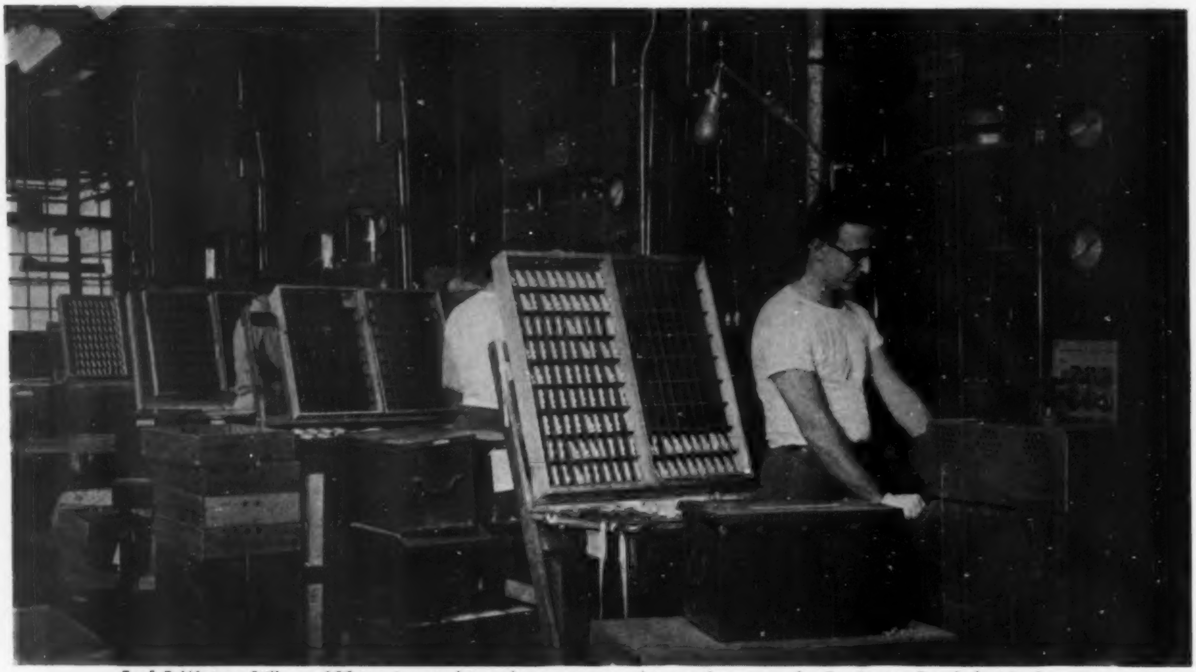


Fig. 6: Load-compression response after hydrolytic aging with live steam for 24 hours. Densities (lb./cu. ft.): rubber—5.7, polyester—2.4, polyether—2.5



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WS-35

Kaolinite fractions, their effect on physical properties of reinforced plastics

By G. P. Larson*

Kaolinite (china clay) occurs as mixtures of two shapes, plates and stacks. Mixtures of these two shapes are found in natural deposits. Stacks are concentrated in the coarser fraction and plates are concentrated in the finer fraction. Kaolinite fractions composed mainly of stacks or plates are obtained by centrifugal fractionation. Each fraction has its own specific properties.

Every physical property tested, except impact strength, was significantly improved by the addition of kaolinite to reinforced diallyl phthalate plastic. Improved physical and water absorption properties were also obtained with an epoxy resin and a medium unsaturated polyester by the addition of the proper kaolinite fraction as filler. A number of physical properties were improved by use of the proper kaolinite fraction in other unsaturated polyesters, chlorinated polyesters, and phenolic resins.

Plastics reinforced with fibrous glass and filled with kaolinite (china clay) are being used extensively today in commercial applications. In a review of the literature, Shannon and Beifeld (1)[1] report the general effects of mineral fillers on the physical properties of fibrous glass-reinforced polyester. Price and Raech (2) give an excellent review of the effects of kaolinite on reinforced polyesters and compare it with other mineral fillers currently used. The major advantages of the kaolinite clay filler over other fillers tested were improved smoothness and gloss, lower peak polymerization temperature and shrinkage, reduced water absorption, improved physical properties, and lower material costs.

All the previous data cover the use of kaolinite fillers in polyesters. No recent data were available on the other resins currently used with fibrous glass reinforcements such as the epoxy, flame-resistant polyesters, diallyl phthalate, and phenolic types. Therefore, an investigation was carried out to determine what effect various types of kaolinite would have on the physical properties of the fibrous glass-reinforced resin systems currently used. For purposes of comparison and completeness of this report, the effects of kaolinite fillers on the physical properties of polyester systems are also included.

Materials

Resins: The resins chosen for this study are shown in Table I, below. An effort was made to evaluate the representative types of the resins currently available.

Glass: The fibrous glass mat used had a Garan finish. The reinforced plastics used in all tests including the controls contained 25% (by weight) of the mat.

China clay: Kaolinite may be represented empirically by the following formula:

$$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$$

However, Fig. 1, p. 158, gives a much clearer picture of the way the elements are combined. It shows that the silica, alumina, and water are not present in their free state, but are completely tied up with each other in the crystalline structure (3). Other chemical elements in trace amounts are also present in the kaolinite. A typical chemical analysis is shown in Table II, p. 158.

In the natural state kaolinite has a wide particle-size distribution. Centrifugal fractionation (4, 5, 6) provides an economic method of separating the crude kaolin into many particle-size fractions. The greatest advantage of this is that each individual fraction possesses its own set of properties.

Figure 2, p. 160, shows the particle-size distribution of kaolinite fractions commercially avail-

Table I: Resins used in evaluation of clay fillers

Type of resin	*Tradename*	*Producer*
Polyesters		
Low unsaturation	Plaskon 9411	Barrett Div., Allied Chemical
Medium unsaturation	Selectron 5003	Pittsburgh Plate Glass Co.
High unsaturation	Laminac 4128	American Cyanamid Co.
Flame-retardent polyester		
Tetrachlorophthalate	Marco 33C	Celanese Corp. of America
Het acid	Hetron 32A	Hooker Electrochemical Co.
Diallyl phthalate (DAP)	Dapon 60	Ohio-Apex Div., Food Machinery & Chemical Co.
Epoxy	Bakelite 18794	Bakelite Co., Div. of Union Carbide Corp.
Phenolic	Plyophen 167	Reichhold Chemicals, Inc.

*Georgia Kaolin Co.
[1] Numbers in parentheses link to references at end of article, p. 237.

Table II: Typical chemical analysis of kaolinites

Aluminum oxide	38.38%
Silicon dioxide	45.30
Ignition loss at 950° C. (combined water)	13.97
Iron oxide	0.30
Titanium dioxide	1.44
Calcium oxide	0.05
Magnesium oxide	0.25
Sodium oxide	0.27
Potassium oxide	0.04

able. Most minerals commonly used as fillers retain their same general shape through all particle-size ranges. However, this is not true in the case of kaolinites. When the kaolinite particles are smaller than 2 microns in size, most of the particles exist as thin, flat hexagonal plates which are approximately 1/10 as thick as their nominal diameter (see Fig. 3, p. 160).

Larger than 2 microns, they generally exist as stacks of these plates (Fig. 4, p. 160) so firmly bound together by natural forces that they act as a single particle (7).

Grades containing large percentages of plates have different surface areas and packing relationships than grades containing large percentages of stacks. Typical physical test results for the different clay fractions are shown in Table III, p. 162.

Three representative kaolinite fractions were selected for this study: 1) Hydrite, which contains 80% of the plate fraction; 2) Hydrite PD-121, which contains approximately equal amounts of the plate and stack fraction; and 3) Hydrite Flat D, which consists of 75% of the stack fraction. The filler percentages shown in Figures 5 through 9 refer to the amount (by weight) of kaolinite which is contained in the finished laminate.

This means that the control panels with no kaolinite had a 75% resin content (and 25% glass mat content), whereas the panels with kaolinite added had decreasing resin contents, down to 25% resin content for the panel containing 50% kaolinite. The corollary effects of decreasing resin content with increasing kaolinite addition should be kept in mind in interpreting the results reported in this article.

Test methods

All resins were fabricated with fibrous glass mat and filler into 1/8-in.-thick panels. The specimens required for the various tests were cut from these panels. A.S.T.M. standard tests were used as follows:

Compressive strength
D 695-52T
Tensile strength
D 638-52T
Flexural strength
D 790-49T
Impact strength (Izod)
D 256-47T (unnotched)

Water absorption was measured on 2-in.-square samples, immersed in water for 24 hr.; the percentage increase in weight was taken as the water absorption. The fabricating techniques are discussed under each resin tested. Smooth curves were drawn through the data to show the trend of the properties tested.

Polyesters

Three major types of polyester resins (low, medium, and high unsaturation) were investigated. Seventy parts of these resins were copolymerized with 30 parts (by weight) of styrene.

A slow-speed propeller agitator was used successfully to blend the kaolinite into the styrene, polyester, and catalyst mixture. It was observed that mixtures with over 40% of clay showed thixotropic or rheopectic viscosity behavior. The thixotropic effect has an advantage of eliminating resin run-off in large moldings. Increases in the viscosity of the mix after 24 hr. at ambient temperature was essentially the same for both the filled and unfilled resins of the three types of polyesters tested. Using the standard S.P.I. exotherm test, it was found that the peak temperature was greatly reduced with the use of kaolinite; it was reduced as much as 50° F. in the low unsaturated polyester and from 50 to 180° F. in the high unsaturated resin. The time to reach the peak temperature was increased and varied up to as much as 20% longer for the low unsaturated resin. The polyester panels were molded at 240° F. at 100 p.s.i. pressure for 5 min. using a closed mold without pinch offs.

Marginal effects on water absorption were observed by the use of kaolinite in the low unsaturated polyester (Fig. 5, p. 162). Also, kaolinite had slight effect upon the flexural (Fig. 6) and tensile strength (Fig. 8) of this polyester, although the compressive strength (Fig. 7) was considerably improved. The impact strength data have some scatter (Fig. 9). Because of this, it is difficult to accurately predict the effect of kaolinite on this property.

In the case of the medium unsaturated polyester, the water absorption was greatly reduced by the addition of kaolinite (Fig. 5). Kaolinite with a high percentage of plates gave improved compressive strength (Fig. 7) while kaolinite with a large fraction of stacks gave improved flexural (Fig. 6) and tensile (Fig. 8) strengths to the medium unsaturated polyester. The impact strength data (Fig. 9) had some scatter; however, it would appear that the kaolinite had beneficial effects on this property.

The highly unsaturated polyester showed only a slight reduction in water absorption with the addition of kaolinite containing

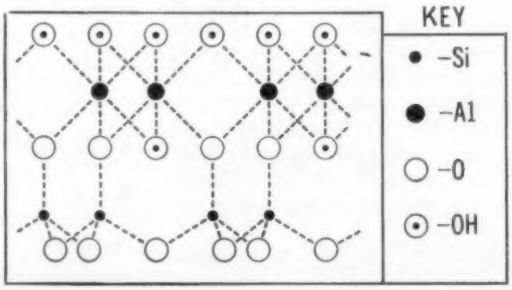

Fig. 1: Structural diagram of unit cell of crystal lattice of kaolinite

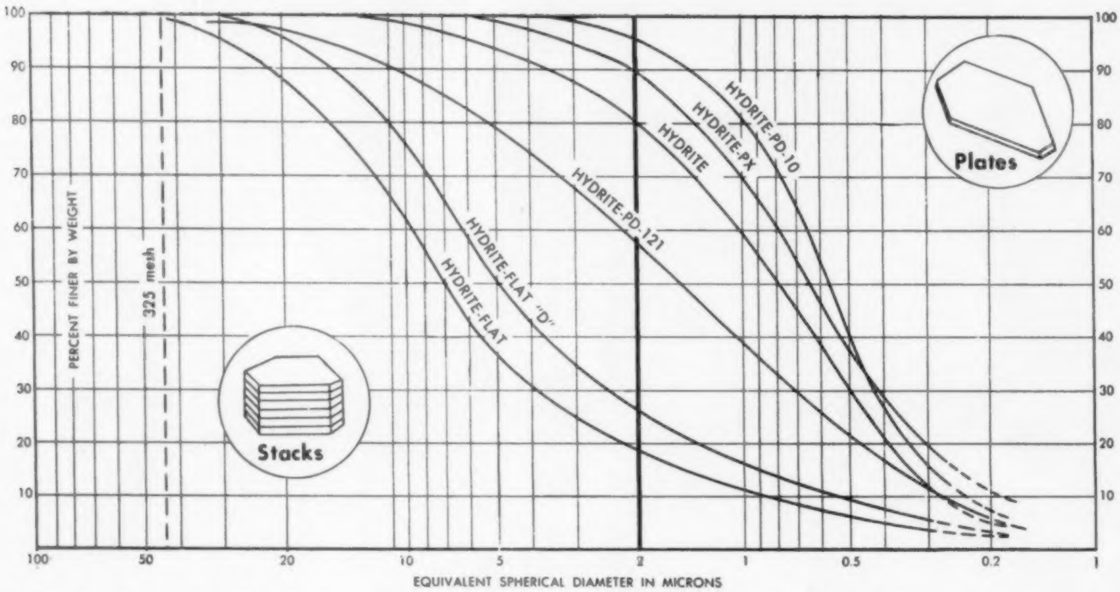

Fig. 2: Particle size analysis of commercial kaolinites by centrifugal-Casagrande hydrometer method

a large amount of plates (Fig. 5). This clay also gave slightly higher flexural (Fig. 6) and compressive (Fig. 7) strengths over other types of kaolinite. The tensile strength (Fig. 8) was essentially unaffected by the kaolinite filler. Again the data on impact strength (Fig. 9) were scattered; because of this it is difficult to predict accurately the effect of kaolinite on this property.

It appeared from these data that the kaolinite with a high percentage of plates gave the greatest reinforcing effect and the lowest water absorption to the polyester resins. This was especially true in the case of the medium unsaturated polyester which had the largest improvement in physical properties from the addition of kaolinite.

Flame-resistant polyesters

The two types of chlorinated polyesters tested were tetrachlorophthalate anhydride (TET) resin and hexachloroendomethylene tetrahydrophthalic acid (HET acid) resin. The kaolinite was mixed into the liquid resin by means of a slow-speed propeller agitator until thoroughly blended. It was found that at the 40% filler level and above the kaolinite-resin mixture became rheopectic. The panels were molded at 240° F. under 100 p.s.i. pressure for 5 minutes.

The effect of the kaolinite on the exotherm properties of the resin was marked. In general, the peak temperature of the filled resin was from 100 to 150° F. lower (depending on the type and amount of kaolinite) than that of the unfilled TET resin and from 50 to 75° F. lower with the HET acid resin.

The time needed to reach the peak temperature was about 20% longer for the filled TET resin and about 40% longer for the filled HET acid resin. Viscosity build-up after 24 hr. at ambient temperature conditions was approximately the same for both the filled and unfilled compositions.

The effects of the various kaolinites on water absorption with the TET resin are shown in Fig. 5. The kaolinite that contained a mixture of plates and stacks greatly reduced the water absorption characteristics. This type of kaolinite had relatively little effect upon flexural (Fig. 6) and compressive (Fig. 7) strengths of the TET resin. The clay fractions containing stacks had the best effect upon the tensile (Fig. 8) and impact (Fig. 9) strengths of any of the kaolinites tested with this resin.

The use of a kaolinite fraction containing a mixture of plates and stacks with the HET acid resin had no significant effect upon the water absorption of the resin. Other kaolinite fractions actually appeared to increase the

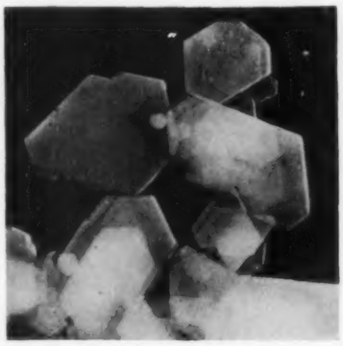

Fig. 3: Electromicrograph of kaolinite plates. Largest particles are approximately 1 micron long

Fig. 4: Side view of kaolinite stacks. Large particle is about 7 microns equivalent spherical dia.

Table III: Typical physical test results for kaolinites

Grade	*Average particle diameter*	*Brightness (G. E.)*	*pH*[a]	*Moisture (max.)*	*325-mesh residue*[b] *(max.)*	*Oil absorption*[c]	*Typical aqueous viscosity*[d]
	microns	*% of MgO*		%	%	%	cp.
Hydrite Flat	7	80.2-83.8	4.2-5.2	1	0.5	27	275
Hydrite Flat "D"	4.5	80.2-83.8	4.2-5.2	1	0.15	28	275
Hydrite PD-121	1.5	83.0-84.5	4.2-5.2	1	0.10	32	285
Hydrite	0.77	84.2-85.8	4.2-5.2	1	0.02	36	290
Hydrite PX	0.68	86.2-87.8	4.2-5.2	1	0.02	39	400
Hydrite PD-10	0.55	87.0-90.0	4.2-5.2	1	0.02	41	430

[a] pH of a 20% aqueous slurry.
[b] A.S.T.M. D 185-45.
[c] A.S.T.M. D 281-31 (spatula rub-out technique).
[d] 71% solids, 0.3% sodium hexametaphosphate on weight of kaolinite; measured at 10 r.p.m. on Brookfield viscometer.

water absorption (Fig. 5). Also the mixture appeared to enhance the flexural, (Fig. 6) and compressive (Fig. 7) strengths of HET resin. The tensile (Fig. 8) and impact (Fig. 9) strengths were slightly lowered by addition of clay fillers, although use of the clay with mixed plates and stacks had less effect upon these two properties than did the other types of kaolinites.

The use of a kaolinite fraction that contained a mixture of plates and stacks appeared to give the best physical properties to the HET acid resin. This clay also enhanced many of the properties of the TET resin. The use of a clay fraction with a majority of stacks could also be used to maintain the impact properties and to minimize the loss of the tensile properties.

Diallyl phthalate resin

The diallyl phthalate specimens were prepared using a 70:30 ratio of monomer to prepolymer. The filler was added with acetone to obtain a working viscosity. This mix was hand-spread over the glass mat and the layup was air-dried at ambient temperature. It was further dried at 120° F. for 1 hr. in an air oven. The panels were molded at 300° F. for 10 min. at 250 p.s.i. pressure.

The addition of kaolinites improved the physical properties of the reinforced diallyl phthalate resin. However, some types of kaolinites gave more improvement than others. The kaolinite with a large fraction of plates appeared to have the greatest affect on water absorption (Fig. 5). A kaolinite fraction with a mixture of

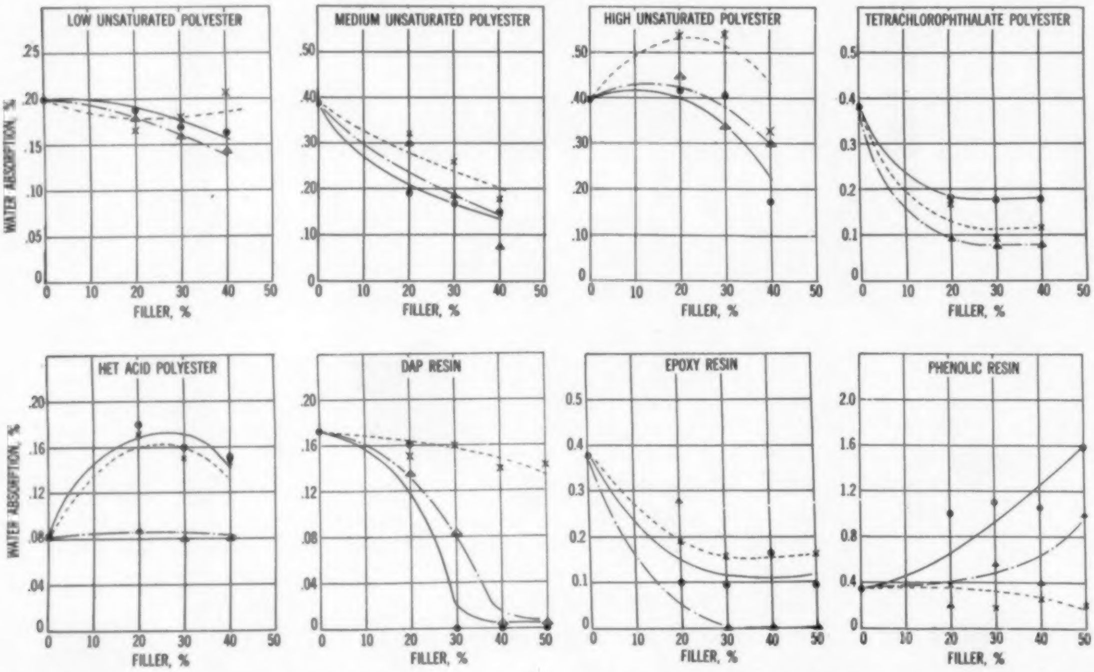

Fig. 5: Effect of kaolinite fillers on water absorption of reinforced plastics. ◉—Hydrite (plates); ×—Hydrite Flat D (stacks); △—Hydrite PD-121 (50:50 mixture)

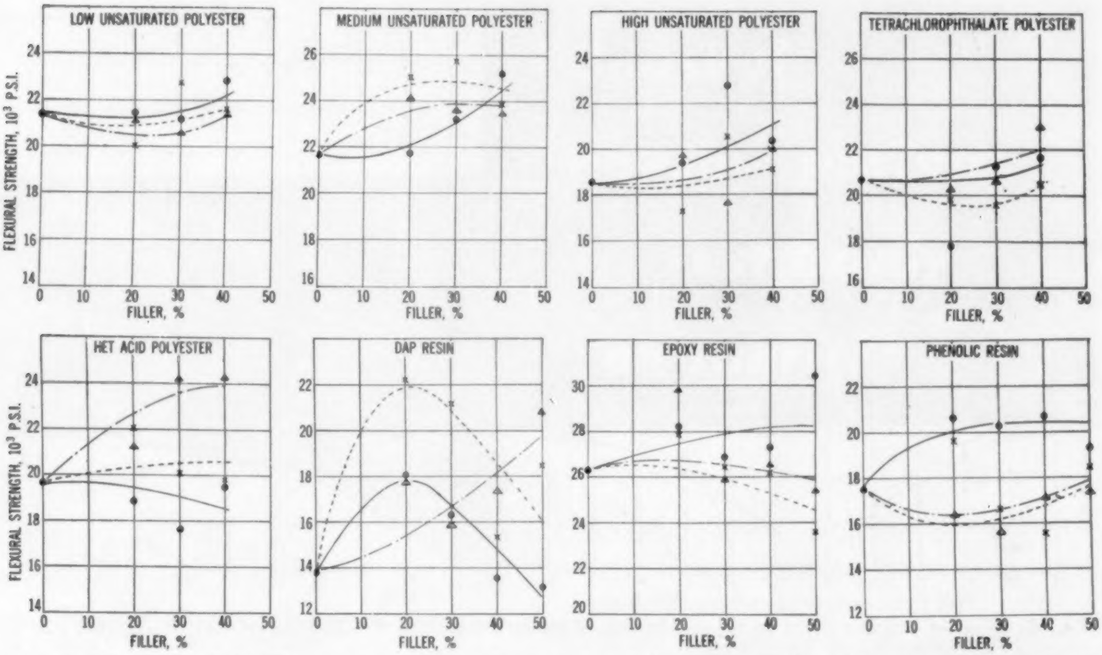

Fig. 6: Effect of kaolinite fillers on flexural strength of reinforced plastics: ● —Hydrite (plates); ×—Hydrite Flat D (stacks); △—Hydrite PD-121 (50:50 mixture)

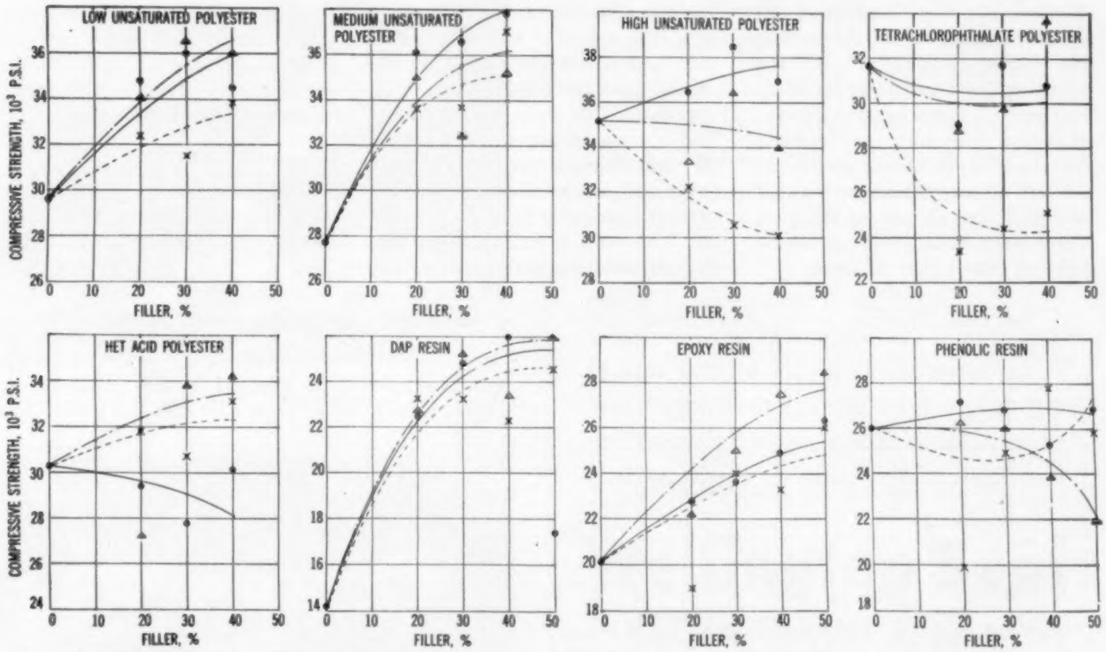

Fig. 7: Effect of kaolinite fillers on compressive strength of reinforced plastics. ● —Hydrite (plates); ×—Hydrite Flat D (stacks); △—Hydrite PD-121 (50:50 mixture)

plates and stacks appeared to give the best flexural, compressive and tensile strengths at high loading (Fig. 6, 7, and 8). This mixture of plates and stacks did not give as much improvement to impact strength as was obtained with other types of kaolinite (Fig. 9).

In general the use of a kaolinite containing a mixture of plates and stacks appeared to give the best over-all improvement in properties of the diallyl phthalate resin. However, every kaolinite gave some improvement.

Epoxy resin

It was possible to satisfactorily mix the epoxy resin, hardener, and kaolinite with a propeller

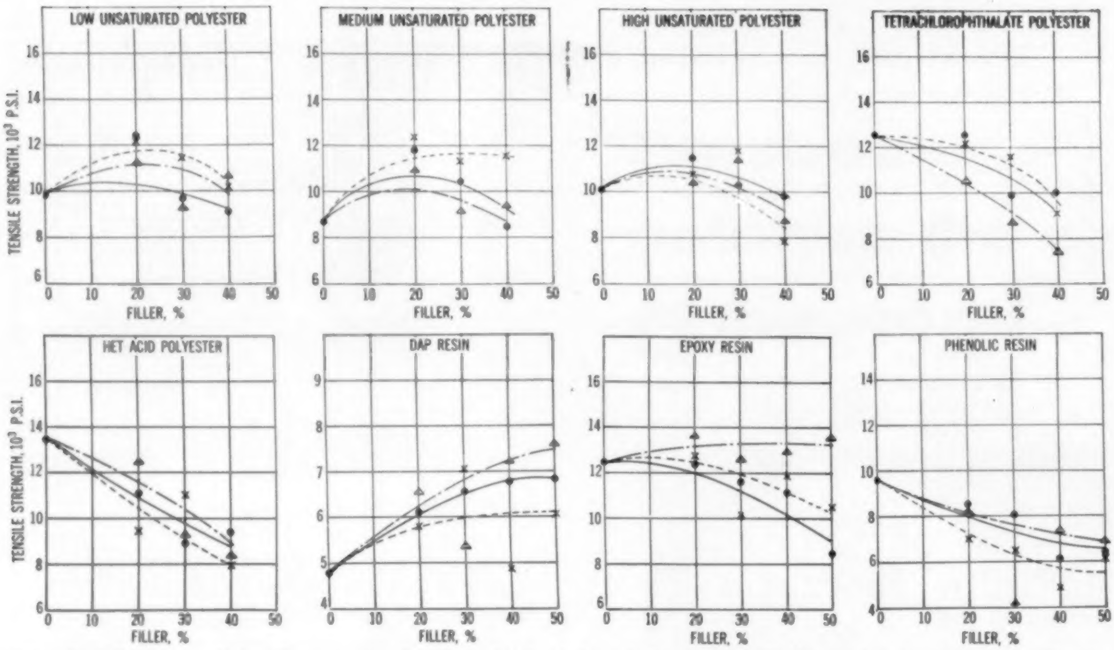

Fig. 8: Effect of kaolinite fillers on tensile strength of reinforced plastics. ◉ —Hydrite (plates); ×—Hydrite Flat D (stacks); △—Hydrite PD-121 (50:50 mixture)

agitator. At about 30% filler the epoxy blends were rheopectic. However, it was found that excellent moldings were obtained at the higher loadings, from the viewpoint of freedom from voids and surface imperfections. It was, of course, necessary to spread the mix carefully to obtain good mold fill-out. The panels were molded at 225° F. for 15 min. at 250 p.s.i. They were then given an afterbake at 260° F. for ½ hour.

The water absorption (Fig. 5) of the epoxy resin was reduced by the addition of filler. Generally, the use of a kaolinite fraction with a mixture of plates and stacks gave the lowest water absorption. This type of kaolinite had no significant effect on the flexural strength but gave slightly improved compressive and tensile strength qualities (Figs. 6, 7, and 8). The only negative effect on the physical properties was a reduction of impact strength (Fig. 9). The use of a kaolinite fraction with equal amounts of plates and stacks gave the best over-all physical properties and minimized the loss of impact strength of the reinforced epoxy resin.

Phenolic resin

The phenolic mixtures were prepared by mixing the preweighed amount of filler with the

(*To page* 236)

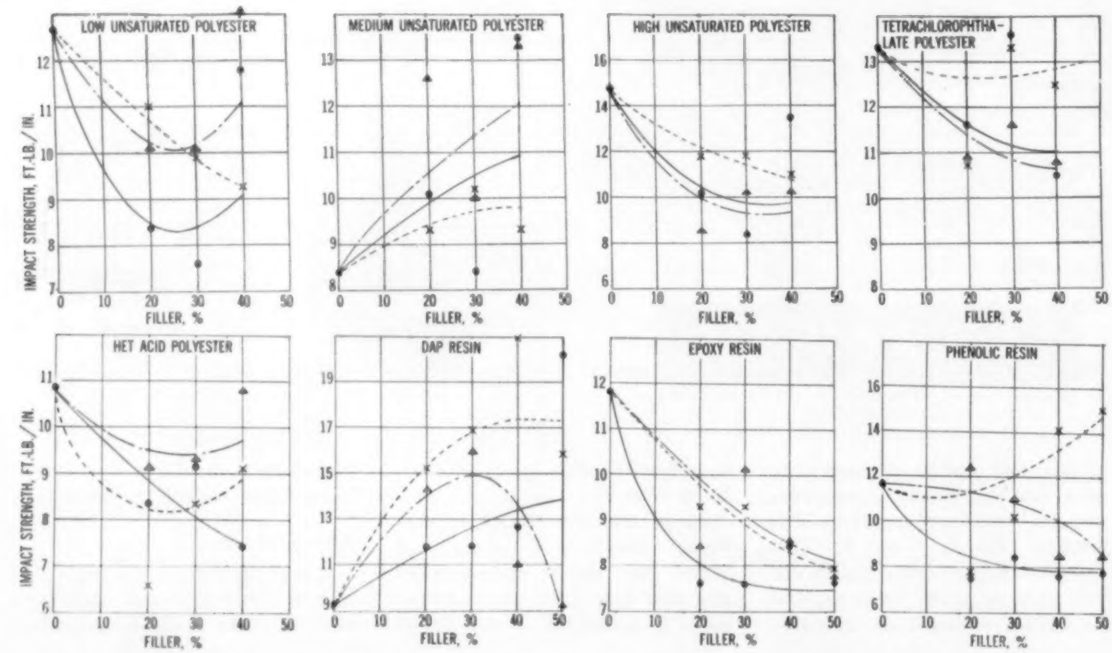

Fig. 9: Effect of kaolite fillers on Izod impact strength of reinforced plastics. ◉—Hydrite (plates); ×—Hydrite Flat D (stacks); △—Hydrite PD-121 (50:50)

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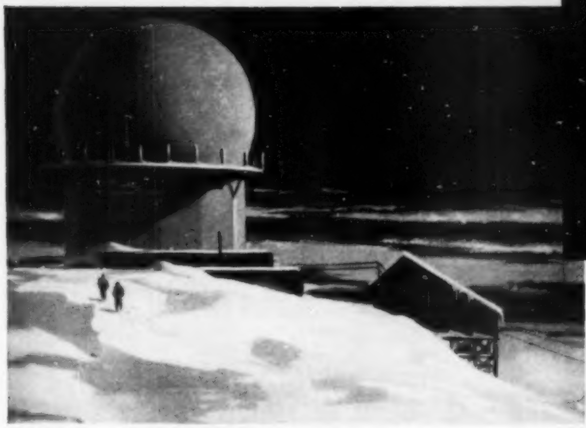

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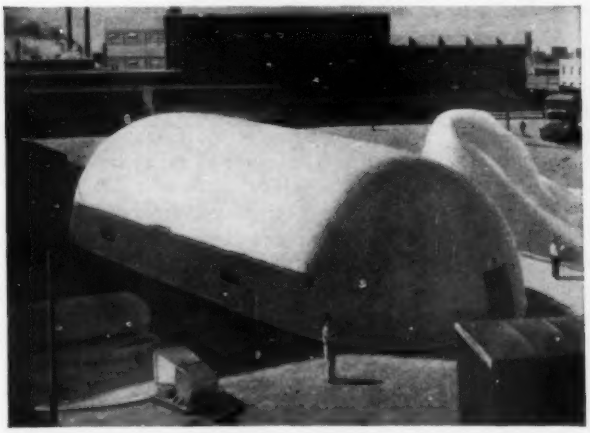

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Materials

Additives check oxidation. Chem. Eng. News *36*, 58-59 (Feb. 24, 1958). Substituted thioethers are effective as antioxidants for polyethylene.

New high-temperature material. Chem. Eng. News *36*, 58 (Feb. 3, 1958). A high-temperature-resistant, felted, asbestos-phenolic plastic is described. This product is available in sheets, rods, and tubes. It is suitable for continuous operation at temperatures up to 500° F. and intermittent operation up to 900° F.

Polypropylene, a promising new plastic. C. Crespi. Materials in Design Eng. *47*, 110-14 (Jan. 1958). Isotactic polypropylene is a colorless, odorless, thermoplastic material with a specific gravity of 0.90 to 0.91. The stress-strain curves for polypropylene subjected to either tensile or compressive stresses are typical of a highly crystalline polymer having a low second order transition temperature. The material has high compressive strength, ranging from 8500 to 9900 p.s.i. It has a relatively high degree of surface hardness, Rockwell R85 to R95, which, coupled with its high elasticity, provides good abrasion resistance. Polypropylene has a melting point of over 300° F. The material behaves as a crystalline solid at temperatures above 212° F., permitting sterilization in water. It has a first order transition temperature at about 340° F. and a second order transition temperature at about −30° F. Isotactic polypropylene is essentially non-polar and has excellent dielectric properties, even at high frequencies. It is resistant to many chemical reactants and at room temperature is insoluble in all organic solvents. The material is sensitive to oxygen at elevated temperatures but can be stabilized with antioxidants. It can be extruded, blown, or injection molded.

New high-melting fiber-forming polymers. A. Conix. Makromol. Chem. *24*, 76-7 (1957). The properties of aromatic polyanhydrides are described. The resins have excellent film- and fiber-forming properties, are highly crystalline, and have high melting points and good stability to hydrolytic degradation.

Graft copolymers. S. H. Pinner and V. Wycherley. Plastics (London) *23*, 27-30 (Jan. 1958). There are many diversified techniques for producing a given graft copolymer. Ionizing radiation may be used to graft almost all polymers. Among other methods by which grafting may be obtained are heavy mastication at elevated temperatures, ultrasonic and ultra-violet irradiation, and thermal energy. Graft copolymers may be separated from the reaction matrix and purified, if no cross-linking has occurred, by means of the differing solubilities of the homopolymers and graft copolymers. The process of graft polymerization produces many interesting and unusual materials, the properties of some of which are discussed. Although commercial use of graft copolymers is not widespread, some general types are being used for special applications. Both fusible and infusible types have important applications. Surface grafting may in the future simplify many of the problems encountered in the fields of synthetic fibers and adhesives.

Molding and fabricating

Now—sprayed reinforced plastics. Product Eng. *29*, 17, 19 (Jan. 13, 1958). A technique is described whereby a twin-nozzled gun is used to spray resin from both nozzles. Catalyst is simultaneously sprayed from one nozzle and an accelerator through the other. Glass fiber rovings are fed through a rotary cutter that shoots the cut rovings onto the plastic-wetted surface. Mechanical properties of laminates made by this process are given.

Joining and fastening plastics. M. W. Riley. Materials in Design Eng. *47*, 129-144 (Jan. 1958). The joining of plastics by solvent cementing, adhesive bonding, thermal welding, and mechanical fastening are described in considerable detail. The most suitable plastics, the bond characteristics, design considerations, and application techniques are included in the discussion. Tables of solvent cements and adhesives are also included. Diagrams and photographs are used to illustrate the various techniques. The section is designed to be used as a manual.

Flow properties of polythene and their effect on fabrication. P. L. Clegg. Brit. Plastics *30*, 535-37 (Dec. 1957). The "melt flow index" may be an over-simplified means of evaluating flow properties of polyethylene. Flow curves based on flow behavior of polyethylene, through cylindrical dies, give information relative to extrusion pressure and output rate. Low output rates may result in swelling of the extrudate, which is a measure of melt elasticity. The critical point of a flow curve, as determined from the double logarithm plot of pressure vs output rate, corresponds to onset of waviness, while surface roughness or mattness, a preliminary to "shark-skin," may occur above or below the critical point. Surface roughness is shown to be a die parallel effect resulting from excessive shear of the polymer, along the metal wall,

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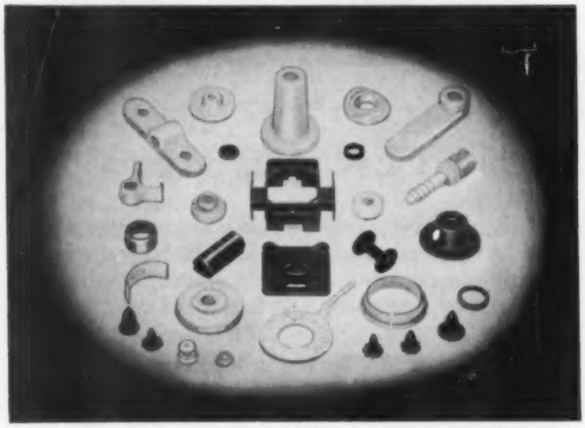

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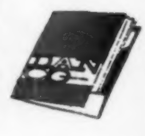

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during extrusion. This defect may be alleviated by running the die at higher temperatures than the melt or increasing the melt or mold temperature. Waviness is caused by irregular flow in the die entry region due to a breakdown in the pattern of streamline flow. Reduction of the cone angle of entry may result in a large increase in the critical output rate, although increased melt or mold temperature may suffice. Surface roughness point, wave point, and "melt flow index" at 1500 p.s.i. may be determined in the laboratory by use of a high shear viscometer. These data, combined with a knowledge of the cause of surface roughness and waviness, may be used to overcome these difficulties.

Applications

Plastics for building. Building Research Station Digest (Gt. Brit.) No. 103, 7 pp. (Oct. 1957). The applications of plastics in building construction are reviewed. The topics considered include load-bearing members, roofing, lighting fixtures, external cladding, internal linings, thermal insulation, vapor barriers, piping, windows, plumbing fixtures, and adhesives.

Resin-silica vs missile-made heat. Chem. Eng. 65, 74, 76 (Jan. 27, 1958). Phenolic resin reinforced with vitreous silica fibers is considered for applications at temperatures as high as 10,000° F. In a 4500° F. burn-through test it out-performs a plate of steel of equivalent thickness by a factor of more than three to one. The material is of particular interest for short-interval, one-shot applications such as liners for rocket engines and nozzles, nose cones for intercontinental ballistic missiles, and heat shields to protect critical components.

Foamed plastics for structural functions in electronic equipment. R. Thielman. Elec. Mfg. 61, 67-73 (Jan. 1958). The application of isocyanate and silicone foams to airborne electronic equipment packaging is discussed. Although there are mechanical advantages in using low-density low-dynamic-response foam materials in packaging, there are certain disadvantages such as low static properties, necessitating the use of thin metal skins to avoid local high stress points, and the cost. Sandwich-type cantilever beams were used to evaluate the dynamic response of foamed plastics compounds. A special device was used to evaluate the silicone foamed materials which are not adaptable to sandwich-type beam specimens. The vibration resistance of sensitive electronic components can be substantially improved by the use of foamed plastics as encapsulating materials.

Humane role for plastic: substituting for various faulty parts of the body. Chem. Week 82, 26-27 (Mar. 1, 1958). Various types of plastics are used in the human body to replace defective tissues. Nylon, Dacron, Teflon, polyvinyl alcohol, Orlon, and poly(vinyl chloride-acrylonitrile) are used for blood vessels. Polyethylene is used for heart valves and stomach wall supports. Polyurethane is used in cosmetic plastic surgery, cellulose acetate for a nerve regenerator in animal studies, and silicone rubbers for heart valves and aortas.

Build or repair with epoxy-glass laminates. T. G. Nock and R. A. Codene. Chem. Eng. 65, 148, 150, 152 (Jan. 27, 1958). Glass-reinforced laminates based on epoxy resins are used in the fabrication of equipment for chemical service. In a new technique the resin and glass cloth can also be used for preparing durable patches for process metal pipe, tanks and pressure vessels. Epoxy laminates used in the chemical industry are of two general types, "general purpose" and "heat resistant." General-purpose laminates incorporate aliphatic polyamines such as diethylenetriamine, which harden epoxy resins at room temperature. Epoxy systems of this type are used in patch repairs. The heat-resistant type is commonly cured with a heat-activated aromatic amine curing agent such as metaphenylenediamine. Such laminates are used for fabricated plastic equipment. Excellent adhesion of resin makes possible patch repair of leaks in

large equipment and thin walled pipes. However, patches should not be applied where the operating temperature will exceed 250° F. The resin will resist only moderately strong acids.

How radiation affects six organic coatings. L. A. Honochs. Materials in Design Eng. *47*, 120-23 (Jan. 1958). The effect of radiation doses of 10^8, 10^9, and 5×10^9 roentgens on six organic coatings are given. Phenolic coatings baked at 500° F. retained their properties better than any of the other coatings evaluated. Unbaked silicone-alkyd enamels appeared to be little affected by 10^9 r. of radiation. After exposure to 10^9 r. phthalic anhydride alkyd enamels were embrittled and a white enamel exhibited a large decrease in adhesion. Epoxy coatings were severely degraded by radiation exposure. Fluorinated vinyl coatings were crosslinked and degraded by the radiation and an exposure of 5×10^9 r. caused an unfused coating to blister and flake. Cellulose nitrate lacquers showed extensive degradation after irradiation and the coatings became porous.

Properties

Resistance of glass fiber reinforced laminates to weathering. L. Gilman. SPE J. *13*, 33-38 (Nov. 1957). Data from a series of government reports not previously published in the literature are analyzed to show the type of data that might be expected from a weathering test program. Strength properties data, obtained on laminates that had been exposed at various outside test sites for three-year periods, are used as the basis of a discussion of dimensional stability properties and the effects of angle of exposure and location of test sites with regard to probable end uses of these materials. A comparison of data obtained from laminates, differing only in the time at which they were made, supports the theory that rapid advances in the technology of resin manufacturing often causes long-term outdoor weathering data to be outmoded at the termination of the test program. Data compiled from the various reference sources are presented for several categories of materials including polyester containing styrene, diallyl phthalate, or triallyl cyanurate monomers, phenol-formaldehydes, epoxies, and silicones.

Pyrolysis of polyamides. S. Straus and L. A. Wall. J. Research Nat. Bur. Standards *60*, 39-45 (Jan. 1958). Thermal decompositions of various nylon samples having different molecular weights and composition were investigated by several procedures: 1) the rate of volatilization at temperatures between 310° and 380° C.; 2) the analysis of the volatile products by mass spectrometry; and 3) a direct measurement of volatilizing material obtained by carrying out the pyrolysis within the ionization chamber of a mass spectrometer. Activation energies based on the rates of volatilization for the various samples varied from 15 to 42 kcal. The

different activation energies appear to be the result of a hydrolytic mechanism which is sensitive to trace polymerization catalysts. Increases in rates were obtained when sulfuric and phosphoric acids were added to nylon.

Infra-red spectra of thermally degraded polyvinyl chloride. R. R. Stromberg, S. Straus, and B. G. Achhammer. J. Research. Nat. Bur. Stds. *60*, 147-52 (Feb. 1958). The changes in chemical structure occurring in polyvinyl chloride as a result of heating in a vacuum in the range 100° to 400° C. were studied using infra-red spectrophotometry. The principal changes occurring in the residue during pyrolysis in a vacuum were the formation of unsaturated structures and a change from an aliphatic spectrum to one showing aromatic absorption.

Testing

Controlled thermal-shock testing of glass-cloth laminates. J. H. Beno, A. M. Dowell, and E. F. Smith. ASTM Bulletin No. 225, 25-28 (Oct. 1957). A method for controlled thermal shock testing, capable of simulating aerodynamic heating, makes use of a molten metal bath as the heating medium. The method is useful in evaluating 1) the resistance to thermal shock of completed assemblies under a variety of simulated flight conditions, 2) the effect of processing variables on the tendency of laminates to blister, and 3) the effect of environmental conditions on laminates subjected to rapid heating. This equipment has also been used in a study of the mechanism by which laminates fail when subjected to severe thermal shock.

Detection of urea, melamine, isocyanate, and urethane resins. M. H. Swann and G. G. Esposito. Anal. Chem. *30*, 107-09 (Jan. 1958). Specific and simultaneous tests for urea-formaldehyde and melamine-formaldehyde coating resins and a test for isocyanate and urethane are presented. A rapid acid-digestion is described for detection of nitrogen, phosphorus, silicon, and titanium. These methods are useful for

qualitative identification of synthetic resins in complex systems. p-Dimethylaminobenzaldehyde is used.

Determination of alpha-glycol content of epoxy resins. G. A. Stenmark. Anal. Chem. *30*, 381-83 (Mar. 1958). The aqueous periodate method for the determination of α-glycol groups in organic materials is inapplicable to epoxy resins because of their insolubility in the reaction medium. A satisfactory alternative involves chloroform as the solvent and an alcoholic solution of a quaternary ammonium periodate as the reagent. This method gives accurate results with pure glycols and is sensitive to small concentrations of glycol groups in epoxy resins. Other functional groups, including epoxy and phenolic groups, do not interfere.

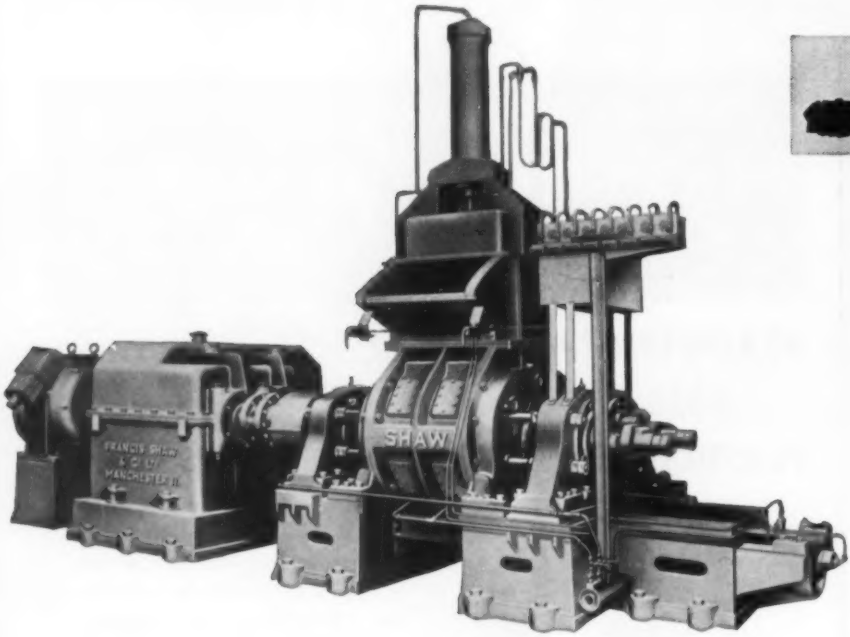
Chemistry

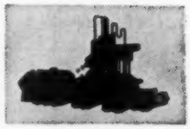
Statistical analysis in a polymerization process. L. A. Pasteelnick and W. B. Leder. Chem. Eng. Progress *53*, 392-95 (Aug. 1957). A statistical analysis of a plant polymerization process is presented. Criteria available to the manufacturing engineer for deciding which variables should be studied in the laboratory and which can be undertaken in the plant are discussed.

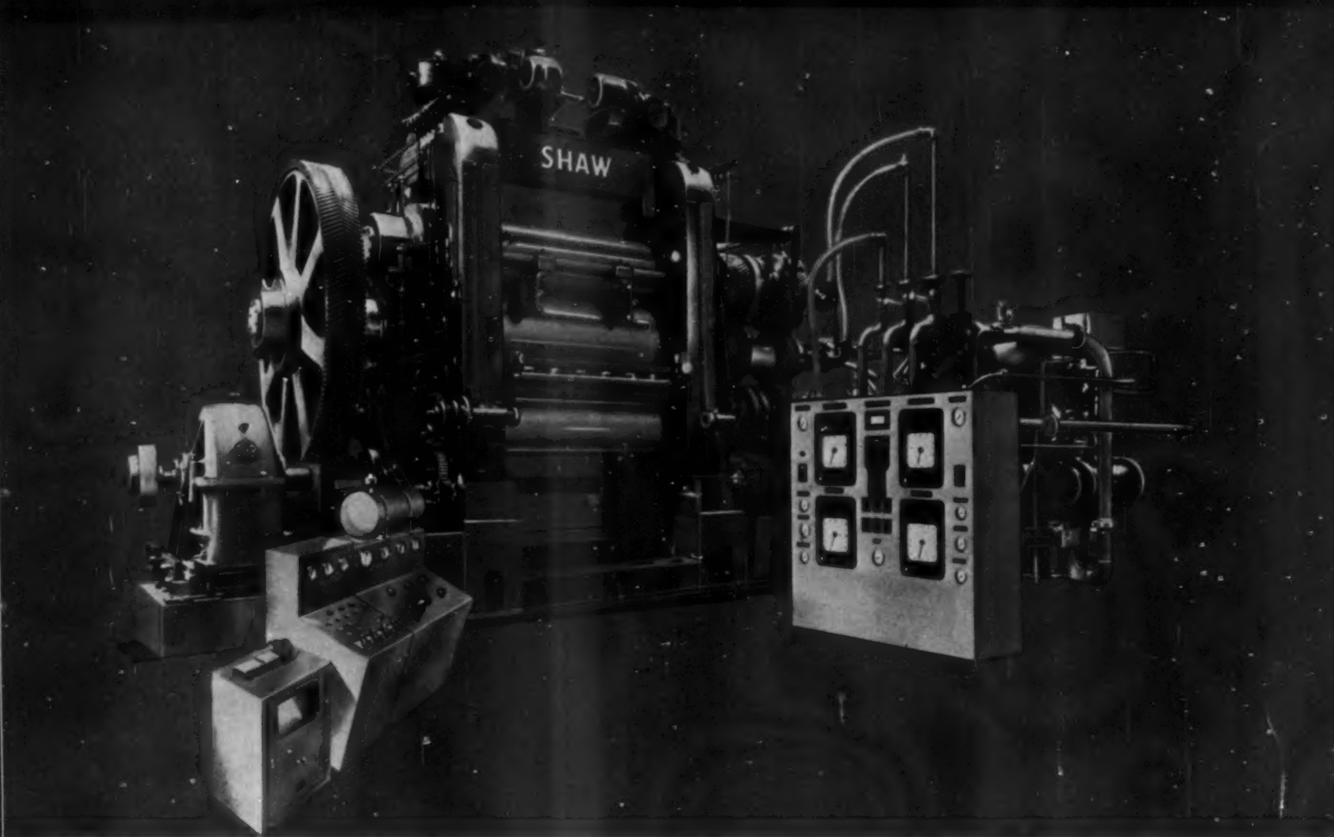
Advances in ionic polymerization of vinyl-type monomer. C. E. Schildknecht. Ind. Eng. Chem. *50*, 107-14 (Jan. 1958). Progress in ionic polymerization processes is reviewed with emphasis on preparation of new stereoregular or eutactic polymers from olefins, diolefins, and vinyl ethers. New ionic polymerizations have promise for development of useful "tailored" polymers and copolymers, because of control of polymer isomerism which is possible in certain heterogeneous systems. New products such as polypropylene plastics, high-cis-polybutadiene rubbers, and vinyl ether polymer adhesives can be prepared only by ionic polymerizations. 129 references.

Polymerization through coordination. I. K. V. Martin. J. Am. Chem. Soc. *80*, 233-36 (Jan. 5,

(*To page* 179)


SHAW





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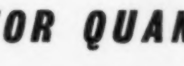

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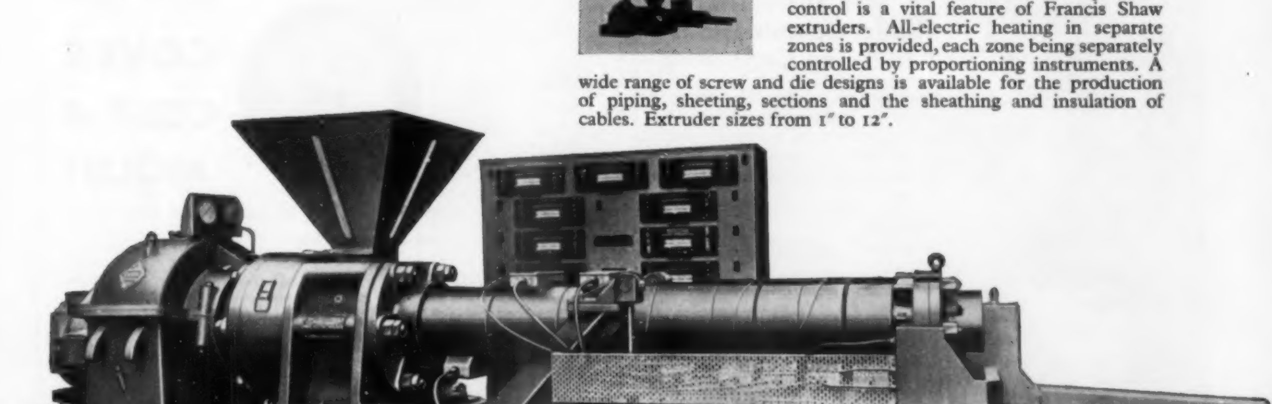

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1958). The need for new rubbers, oils, and plastics that will not decompose at 400° C. has been brought about by recent advances in jet-aircraft manufacture. Heat stability might be realized in a polymer containing recurring chelated metal atoms. Three approaches are available for the preparation of such "coordination polymers." These are: 1) preformed metal complexes may be polymerized through the functional groups which they contain; 2) an organic polymer containing a recurring chelate group can be treated with suitable metal salts to form the metal derivative; and 3) a polymer may be formed by the reaction of a metal atom-donor atom coordination. The synthesis of a number of bis-α-thiopicolinamido compounds by method 3 is described. Investigation of the thermal properties of these polymers shows a number of them to be stable above 300° C. In particular, the 4,4′-bis-α-thiopicolinamido-diphenyl sulfone-zinc polymer can be heated at 360° C. without appreciable loss in weight or change in infrared spectra.

Publishers' addresses

A.S.T.M. Bulletins: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

Analytical Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

British Plastics: Lliffe and Sons, Ltd., Dorset House, Stamford St., London S. E. 1, England.

Building Research Station Digest: Her Majesty's Stationery Office, London, England.

Chemical Engineering: McGraw-Hill Digest Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Chemical and Engineering News: American Chemical Society, 1155 Sixteenth St., N. W., Washington, D. C.

Chemical Engineering Progress: American Institute of Chemical Engineers, 120 E. 41st St., New York 17, N. Y.

Chemical Week: McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Electrical Manufacturing: The Gage Publishing Co., 1250 Sixth Ave., New York, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Journal of the American Chemical Society: American Chemical Society, 1155 Sixteenth St., N. W., Washington, D. C.

Journal of Research of the National Bureau of Standards: Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Makromol Chem: Alfred Hüthig Verlag, Mönchofstr. 15, Heidelberg, Germany.

Materials in Design Engineering: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

Plastics (London): Temple Press, Ltd., Bowling Green Lane, London E. C. 1, England.

Product Engineering: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 36, N. Y.

SPE Journal: Society of Plastics Engineers, Inc., 513 Security Bank Bldg., Athens, Ohio.

U.S. Plastics Patents

Copies of these patents are available from the U.S. Patent Office, Washington, D.C., at 25¢ each.

Copolymers. L. H. Dunlap and R. H. Reiff (to Armstrong Cork). U. S. 2,819,234, Jan. 7. Copolymers of aryl olefins and unsaturated tall oil esters.

Resins. C. K. Fink and K. L. Brown (to Carbide and Carbon). U. S. 2,-819,235, Jan. 7. Vinyl-compatible resins.

Copolymers. J. H. Daniel, Jr. (to American Cyanamid). U. S. 2,819,237, Jan. 7. Aqueous dispersions of an unsaturated monomer and a thermosetting resin.

Resin. R. G. Hart and C. J. Gardner, Jr. (to Borden). U. S. 2,819,238, Jan. 7. Epoxy-modified urea resins.

Coating. R. Colombo (to Lavorazione Materie Plastiche). U. S. 2,820,249, Jan. 21. Coating articles with multiple layer coatings.

Molds. R. M. Fraser (to Fabrica Argentina de Alpargatas). U. S. 2,820,251, Jan. 21. Molds for forming plastic soles on footwear.

Extrusion. R. B. Koch (to Polymer). U. S. 2,820,252, Jan. 21. Extrusion of molten polyamides.

Latices. P. Fram, C. A. Nielsen, and F. Leonard. U. S. 2,820,718, Jan. 21. Reinforced alkylacrylate latices.

Laminates. F. Sorel (to Arvey). U. S. 2,820,733, Jan. 21. Stretched laminates of rubber hydrochloride.

Sealing. L. A. Amborski (to Du Pont). U. S. 2,820,735, Jan. 21. Sealing polyterephthalate ester structures.

Electrodeposition. G. W. Heller (to Du Pont). U. S. 2,820,752, Jan. 21. Electrodeposition of tetrafluoroethylene polymers.

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Polymers. W. S. Barnhart (to Minnesota Mining). U. S. 2,820,772, Jan. 21. Halogenated olefin polymers with fluorinated plasticizer.

Compositions. C. W. Childers and C. F. Fish (to U. S. Rubber). U. S. 2,820,773, Jan. 21. Rubber-resin compositions.

Vinyl resin. C. S. Myers, J. E. Wilson, and R. Bostwick (to Carbide and Carbon). U. S. 2,820,774, Jan. 21. Polyvinyl chloride stabilized with lead salt.

Polyethylene. M. Chamberlain, R. M. Rigterink, and C. L. Stacy, Jr. (to Dow). U. S. 2,820,775, Jan. 21. Stabilized polyethylene.

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Polymerization. T. J. Suen and A. M. Schiller (to American Cyanamid). U. S. 2,820,777, Jan. 21. Synthesis of polyacrylamide.

Polymerization. H. Spaening and H. R. Hensel (to Badische Anilin). U. S. 2,820,778, Jan. 21. Polymerization of olefinically unsaturated hydrocarbons.

Polymerization. C. H. Dale (to Standard Oil). U. S. 2,820,779, Jan. 21. Ethylene polymerization.

Copolymers. D. L. Bailey and R. M. Pike (to Carbide and Carbon). U. S. 2,820,798, Jan. 21. Copolymers of organic silicon compounds and N-vinyl pyrrolidone.

Extrusion. T. T. Bunch (to Western Electric). U. S. 2,820,987, Jan. 28. Controlled application of plastics upon filaments.

Hollow bodies. W. Pfannmueller, A. Letschert, and T. Fuchs (to Badische Anilin). U. S. 2,821,006, Jan. 28. Manufacture of hollow articles having projections on the inner surfaces thereof.

Casting resins. R. G. Black (to Western Electric). U. S. 2,821,082, Jan. 28. Device for determining resistance of casting resins to cracking.

Polymers. A. C. Haven, Jr. (to Du Pont). U. S. 2,821,512, Jan. 28. Polymers of cyclopentadienyl (vinylcyclopentadieneyl)-iron.

Resins. J. S. Strong. U. S. 2,821,513, Jan. 28. Foamable resin compositions.

Resins. F. A. Sattler and S. H. Langer (to Westinghouse). U. S. 2,821,517-8, Jan. 28. Polyesteramide-siloxane resin.

Resins. S. A. Glickman (to General Aniline). U. S. 2,821,519, Jan. 28. Stabilization of polymeric N-vinyl pyrrolidones with hydrazino compounds.

Polymers. R. E. Burnett (to General Electric). U. S. 2,821,520, Jan. 28. Polymers of unsaturated esters of alkoxy benzene dicarboxylic acids.

Polymers. J. A. Price (to American Cyanamid). U. S. 2,821,521, Jan. 28. Polymers of N-(dialkylaminopropyl) maleamic acid.

Resins. W. C. Bauman, H. H. Roth, and H. B. Smith (to Dow). U. S. 2,821,522, Jan. 28. Water-soluble sulfonation products of polymeric vinyltoluenes.

Extruder. J. D. Patton (to Firestone). U. S. 2,821,745, Feb. 4. Extruder for plastic tubing.

Films. L. B. Bicher, Jr. (to Du Pont). U. S. 2,821,746, Feb. 4. Film extruder.

Press. P. H. Rossiter (to Aetna-Standard). U. S. 2,821,747, Feb. 4. Molding press.

Sheet forming. P. H. Bonness (to Square D). U. S. 2,821,751, Feb. 4. Forming indentations in post-formable resin-impregnated material.

Polymers. H. J. Hagemeyer, Jr. and E. L. Oglesby (to Eastman Kodak). U. S. 2,822,339, Feb. 4. Protein-containing polymers.

Polyester. J. D. McGovern and G. B. Duhnkrock (to American Cyanamid). U. S. 2,822,340, Feb. 4. Flame-resistant polyesters.

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Resins. H. P. Wohnsiedler (to American Cyanamid). U. S. 2,822,347, Feb. 4. Triazinylaldehyde resins.

Polyesters. K. E. Muller, W. Bunge, and C. Muhlhausen (to Bayer). U. S. 2,822,349, Feb. 4. Reactions of diisocyanate-modified linear polyesters with urea glycols.

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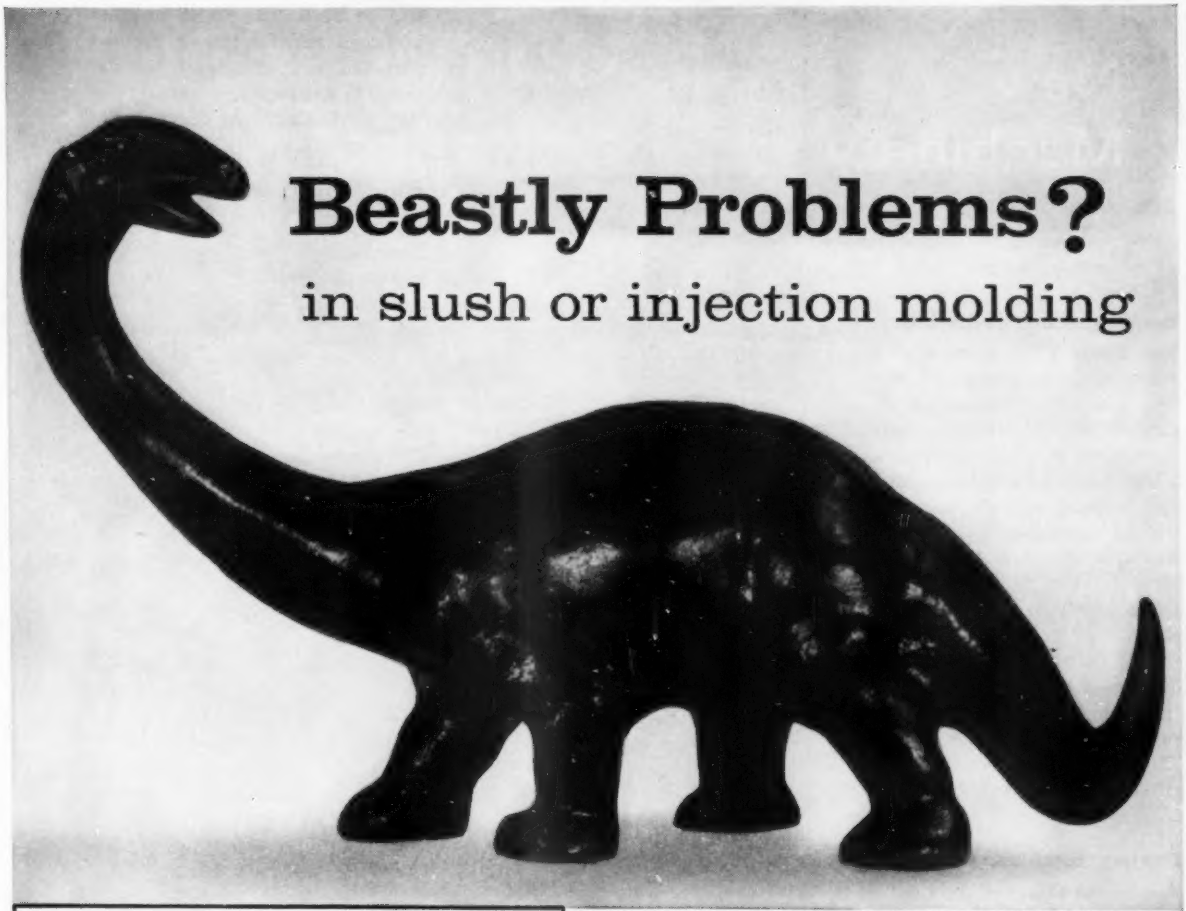

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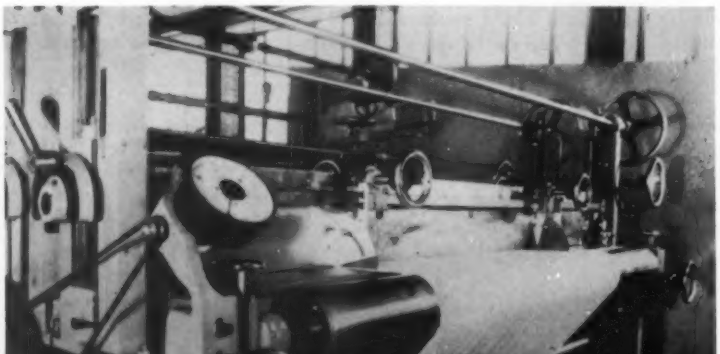
A machine designed for the knife and reverse-roller coating of cloth, paper, and other continuous-web materials with plastics comes equipped with two or three coating heads and is capable of combined operations such as coating application, fusion, embossing, trimming, second-coating, and rewinding. Weight of coating may range from ⅓ to 90 oz./sq. yd. (up to 35 oz. per pass), and web widths up to 80 in. may be handled, though 64 in. is standard. Any desired heating system can be incorporated for fusing and curing. The individual components of this system are available separately. These machines are built by *Hofmann & Schwabe, Wilhelmshof-Allee 96, Krefeld, Germany,* and are sold and serviced in the United States by *Converters Machine Co., 22 W. Putnam Ave., Greenwich, Conn.*

Marking machine

The Acroprinter 401-A is a platen-type printing machine mounted on a cast iron base for convenience in feeding. It applies colored imprints to depressed or sunken cavity letters, or to raised designs. Three sizes are available for marking items ranging from tabs or buttons to small machine housings and formed or molded parts. Dies, ink, and special holding fixtures are extra. *The Acromark Co., 5-15 Morrell St., Elizabeth, N. J.*



Hofmann & Schwabe coating appliance, showing coating table with coating knife and dial gage for adjustment of coating thickness

Film and sheet laminator

An "all-purpose" laminator can laminate onto both sides of a base web in one operation. It can treat, color, print, pressure combine, and wax combine plastics film, tissue papers, 40-pt. board, and aluminum foil. Interchangeability of key rolls in various sections of the machine keeps roll inventory down; all rolls are fitted with ball bearings. Sectional construction facilitates changes and maintenance. *John Dusenbery Co., Inc., 274 Grove Ave., Verona, N. J.*

Power keyhole saw

An air-driven power saw and file that has only two moving parts quickly and cleanly does keyhole, dead-end, and scroll cutting in all types of plastics—even, it is claimed, in glass reinforced plastics. Operating speed and cutting stroke are adjustable. *Air-Speed Tool Co., 1502 W. Slauson Ave., Los Angeles, Calif.*

Potting resins dispenser

The Model 145B Ecco dispenser was designed to dispense the makers' potting resins, and will probably work with others. Portable, the machine will deliver up to 900 cc. (30 fl. oz.) per shot, on cycles ranging from 0.5 to 40 seconds. Resin temperature may be anything from room temperature to 190° F. ±1°, and liquid viscosities may vary from 0.01 to 10,000 poises. *Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.*

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A huge, jacketed extruder with a nominal screw diameter of 15 in. and an L/D ratio of 18, is designed to deliver about 6500 lb./hr. of thermoplastic extrudate. Steam heated, it is powered by an 800-hp. drive offering speeds ranging from 6 to 60 r.p.m. at constant torque. Extra-heavy

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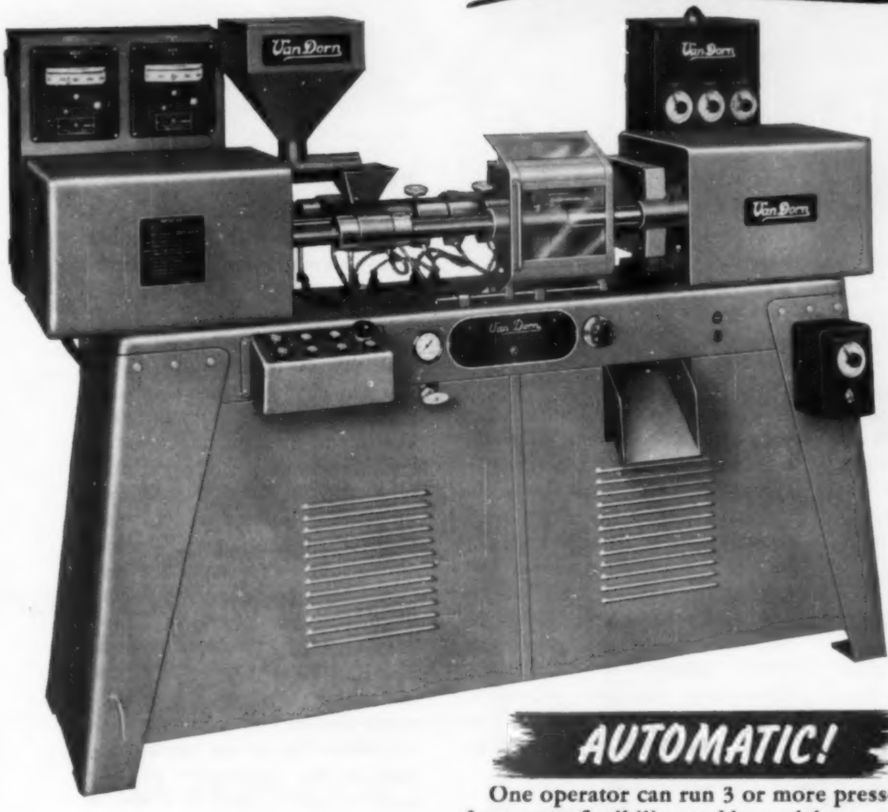

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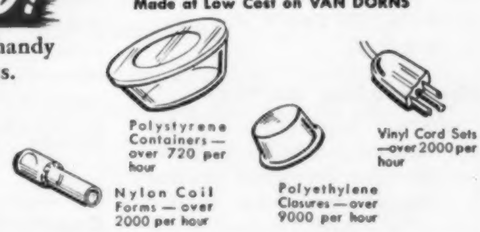

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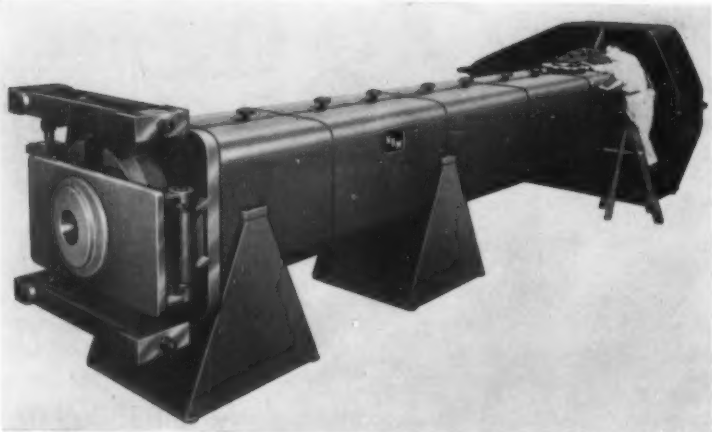

NRM 15-in. steam-heated thermoplastic extruder is designed to deliver about 6500 lb./hr. of thermoplastic extrudate

herringbone gears and special thrust bearings are said to provide a working life of 25,000 hr. at 10,000 p.s.i. head pressure. Cylinder is lined with Xaloy 306. *National Rubber Machinery Co., 47 W. Exchange St., Akron 8, Ohio.*

Film printing line

Offered as a package unit, a 2-color flexographic printing press is coupled with an unwind J-box, a 48-ft. drying tower, and a rewind compensator. Production rates up to 1500 yd./hr. can be achieved with polyethylene film. The set-up is flexible enough to incorporate additional operations —laminating, coating, embossing —if desired. Widths up to 72 in. may be processed. *Liberty Machine Co., 275 Fourth Ave., Paterson 4, N. J.*

Checkweighing machines

"Selectrol" models 144 and 145 are accurate scales for weighing preforms for thermoset molding or for checkweighing molded parts of any kind. They are available in capacity ranges from 1 g. (0.03 oz.) to 100 lb., and offer weighing accuracy in the range of 0.01 per cent. The Model 144 employs a rotary transfer mechanism with one loading station, one weighing station, and two discharge stations. Model 145 has an in-line, "walking deck" transfer mechanism. Either can be specially engineered to fit into a molding production setup. Both are based on "Shadograph" scales that compare the quantity weighed against calibrated counterweights and indicate difference by a parallax-less projection system. (These scales are also available without the transfer mechanism for use in general weighing service.) Depending on capacity and accuracy desired, Models 144 and 145 can make up to 60 weighings per minute, and other even faster models are available. Accessories include recorders, counters, signaling devices. *The Exact Weight Scale Co., 944 W. Fifth Ave., Columbus 15, Ohio.*

Line of extruders

The new EPE line of induction-heated extruders offers 2.25-, 3.5-, 4.5-, and 6-inchers in L/D ratios from 16 to 30. Xaloy lined, the barrel (on the 2.5-in. machine) is 1 in. thick and is encased in aluminum cooling channels into which are built the low-frequency induction coils that do the heating. Drive is customer's choice, with herringbone reduction gears. Specifications on the machines of $L/D = 20$ are listed in the accompanying tabulation. The company also offers a line of extrusion accessories — dies made to order, pipe pullers, cooling equipment, pelletizers, windups, etc. *Electrophysical Engineering Co., 930 N. Parker St., Orange, Calif.*

Plastometer

The "Plastograph" is an instrument that, in one form, resembles a tiny sigma mixer. It is designed to measure the plasticity, consistency, resistance to mixing, etc., of materials of relatively high viscosity at temperatures up to 300° C. The instrument actually measures the torque on the drive shaft, which turns at 30 or 60 r.p.m., and this torque is recorded on a strip chart. Several different mixing chamber designs are available to simulate the actions of various commercial mixers. One model is designed for continuous process monitoring. It has been established for several common plastics that there is a good correlation between the Plastograph results, and the usual solution viscosities of the same samples, so the instrument can be used to follow molecular weight changes during polymerizations. The torque range is easily changed without interrupting operation; thus materials ranging in consistency from paints to rubbers and heavy pastes can be tested with precision. Because the viscosity of a vinyl mixture at a given temperature depends on the stability at that tempera-

Engineering data on EPE extruders, LD-20:1

Model	C-250	D-350	D-450	D-600
Cylinder I.D., in.	2.5	3.5	4.5	6.0
Output, lb./hr.	80-130	140-200	250-400	450-700
Max. screw speed, r.p.m.	100-120	90-100	75-90	75
Drive, hp.	20	40	60	100
Reduction gear ratio	10.43:1	19.7:1	28.5:1	28.7:1
Thrust bearing rating @ 100 r.p.m., tons	15	38	63	118
No. heating zones	3	4	4	4
Maximum demand, kw.	13.5	27	33.6	
Heat up time, ambient to 400° F., min.	20	30	45	55

ture, the instrument also provides an indirect measure of vinyl stability. A very versatile tool. *C. W. Brabender Instruments, Inc., P. O. Box 106, S. Hackensack, N. J.*

High-pressure valves

A line of spring-loaded check valves for oil and water service at pressures up to 4000 p.s.i. features inverted-seat design, said to be self-cleaning. Available sizes range from ½ to 2 in. NPT. Body and seat retainer are Navy M bronze; seat, stem and guide are stainless steel; spring is Inconel. *Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11, Ohio.*

Ribbon blenders and mixers

These ribbon blenders, available in mild or stainless steel, come in 13 models ranging in capacity from 10 to 400 cu. ft. and in ratings from 3 to 40 horsepower. The ribbon assembly may be quickly removed for cleaning. Discharge ports and seals are tight, so liquids may be processed without leakage. *The Falcon Mfg. Div., First Machinery Corp., 211 Tenth St., Brooklyn 15, N. Y.*

Intended for similar duty as the above blenders, the Marion Twin Mixers are available in eight sizes handling from 50 to 8000 lb. of material (based on density of 32 lb./cu. ft.). These differ from the standard type blender in that two shafts operate side by side in a single mixing chamber. *Rapids Machinery Co., Marion, Iowa.*

Foam profile cutter; splitter

A line of foam cutting machines, made in Germany, includes five classes of machines: the 69SL group is intended for horizontal splitting of long blocks (up to 5 yd.) of foam in widths up to 64 or 80 inches. The 69SV machines are designed for splitting shorter blocks in widths up to 48, 64, or 80 inches. Layers as thin as 40 mils can be handled with these splitters. The Model 70V machine is intended for vertical splitting and can be had with a beveling attachment. The 69KR machine delivers a continuous foil of foam from a cylindrical chunk—essentially a skiving operation; widths from 42 in. to 80 in. can be handled on the three models, and maximum foil thickness is 0.4 inch. The *piéce de resistance* of this whole family is the 69KP series, which are designed to cut profiles from foam slabs. With suitable attachments, foam slabs can be contoured to ridged surfaces of trapezoidal, triangular, or sinusoidal cross section, in a single pass. Zigzag ribbed surfaces or humped surfaces can also be cut. *Fecken-Kirfel* foam splitting machines are distributed in the U.S. by *General Foam Corp., Valmont Industrial Park, Hazleton, Pa.,* and in Europe by the parent company at *Goebbelgasse 15, Aachen, West Germany.*

Cutter for extrusions

A high-speed automatic cutter for extruded soft plastics and rubbers, the Model F6, is clutch-and-brake operated, makes a single revolution per cut, at up to 500 cuts per minute. It develops a torque of 60 in.-lb., about

enough to cut ordinary garden hose, and its single blade accelerates from 0 to 1150 r.p.m., cuts, and stops, all in one revolution. A big brother, the F7, now under development, will have four times the torque and make up to 200 cuts per minute. Because of its very fast response, the F6 cuts lengths to extremely close tolerances, frequently below 0.02 inch. A special model with four blades makes up to 7000 cuts per minute. Thin washers may be sliced off accurately, and thin-wall tubing is not collapsed by cutting. Cuts may be made as at low a rate as an ounce every 6.5 minutes. *Foster & Allen, Inc., 628 South Ave., Garwood, N. J.*

Marking machines

The heart of this maker's line of marking machines is the Model AC-1, an air-operated hot press stamper, which is easily adapted to the stamping of a wide range of plastics parts. The press is a bench model, foot-pedal operated, with a top imprint area of about 2 by 4.2 inches. Work platform is 10 by 10 in., equipped with back and side gages and removable, self-centering type and die chase. Daylight space is 4 inches. The AC-1 forms the basis for over a dozen special purpose stampers. The maker also offers five other machines for striping, small-part stamping, gold stamping, and rotary embossing, with modifications. Dies, roll leaf, and fixtures are also available. *Ackerman-Gould Co., 92 Bleecker St., New York 12, N. Y.*

Semi-automatic compression press

A 500-ton, upward-acting press has a double ram—main and booster—for a fast closing followed by application of high pressure. The self-contained, open-circuit hydraulic system is powered by a 25-hp. radial-piston pump. A versatile knockout arrangement is provided, with ejectors automatically actuated and reset by the return movement of the ram. Press may be run either by hand-operated switches, or under control of a timer. Usual cycle elements are included. Stroke is 36 in., effective daylight is 69 in., maximum mold size is 36 by 42 inches. Top closing speed is 3.5 in./min., pressing speed is 13.4 in./min., opening speed is 106 in./minute. *Hydraulic Press Mfg. Co., Mount Gilead, Ohio.*

Spray painting booth

An automatic spray booth is designed for high-production spraying of small parts—up to 6000 per hour, depending on size. The booth may be equipped with a dry or water-washed filter. Parts move through booth on spindles attached to a roller chain powered by a variable-speed drive. Spindles rotate as they pass sprayers. Automatic or semi-automatic loading and unloading of work holders is optional. Work holders may perform masking function, too. *Schweitzer Equipment Co., 3764 Ridge Rd., Cleveland 9, Ohio.*

Extruder for TFE resin

Tetrafluoroethylene resin, though a thermoplastic, cannot [yet] be processed in screw extruders, and

Davis-Standard extruder for tetrafluoroethylene resin is of reciprocating-ram type

ram-type extruders are used. A new reciprocating-ram extruder, developed for making TFE resin products up to ½ in. in O.D., is said to deliver smooth, properly cured extrudates, such as heavy-walled tubing, in continuous service. The simplicity of operation makes it possible for one operator to run several machines. The machine operates satisfactorily on the lower-cost, powder-type TFE compounds. *Davis - Standard, Mystic, Conn.*

High-speed physical tester

The Plastechon has been designed to measure tensile, flexural, and stress-relaxation properties of materials at rates of loading up to 100 lb./millisec., corresponding to elongation rates of 100 to 200 in./second. Stress-strain or stress-time plots are displayed on an oscilloscope and may be photographed for record. This instrument gathers data at rates of loading equal to those encountered in actual impact service, an area in which designers have felt particularly handicapped by lack of adequate data. *Plas-Tech Equipment Corp., 751 Main St., Waltham 54, Mass.*

Laboratory mill

A two-roll laboratory mill has rolls 6 in. in diameter and 13 in. long. Journal necks are 4 in. in diameter. Drive is 7.5-hp. motor and reduction gears. Features include: hardened, ground steel rolls; forced feed lubrication; micrometric roll adjustments; and knee-type safety controls. *JMC, 683 Frelinghuysen Ave., Newark, N. J.*

Books & Booklets

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Polyurethanes"

By Bernard A. Dombrow

Published in 1957 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 176 pages. Price: $4.50

This little volume is a clear presentation of the history, chemistry, and current and potential uses for urethanes. Separate chapters deal with rigid, semi-rigid, and flexible foams, rubbers, adhesives, coatings, textiles, and such miscelleaneous applications as potting and encapsulating of electronic components. Diagrams and photographs clearly illustrate foaming and fabricating machinery and techniques. Physical properties and comparative data are shown in a large number of tables and graphs.

An excellent bibliography further enhances the value of this up-to-date survey of the whole field of urethanes.

"Polyamide Resins"

By Donald E. Floyd

Published in 1958 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 230 pages. Price: $4.50

Number 3 in the Plastics Applications series, this book is similar in plan and level of treatment to the others in the series. After a brief introduction, there are nine chapters dealing with properties, chemistry, manufacturing processes, and uses of polyamides in coatings, fibers, molding, adhesives, dispersions. The last chapter discusses the future of these resins. The book is best in its coverage of applications of nylons—fibers, in particular, are well covered. There is a good deal of space given to polyamide —11 (Rilsan), which is rather new to the U. S. Mixtures and co-polymers are important in tooling and adhesives, and many readers will find new information here. Unfortunately, the book is marred by a number of small editorial errors.—*J.F.C.*

"Der Schlagversuch in der Werkstoffpruefung"

By Wilhelm Späth

Published in 1957 by A. W. Genter Verlag, Stuttgart, Germany. 179 pages. Price DM 21.50 (ca. $5.10). In German.

Heart of this volume is the presentation of a new impact testing technique. Conventional methods measure only the energy input. In Dr. Späth's technique, not only is energy input determined, but maximum load as well. This additional value is obtained in routine fashion during impact testing. Equipment for the new test is described.

Other topics covered in this three-part work include: testing techniques and results on various materials (part I), impact tests with the new equipment (part II), and the role of impact testing in materials analysis.

"Glass Reinforced Plastics," 2nd Ed.

Edited by Phillip Morgan

Published in 1957 by Philosophical Library, Inc., 15 E. 40th S., New York 16, N. Y. 280 pages. Price: $15.00

This valuable work ranges over most of the subject matter of the reinforced plastics field, from resin chemistry to practical molding, applications, and design. There are 18 chapters, all by different authors: one on glass fibers, three on polyesters, three on other resins, four on molding and production methods; the remainder deal with applications in the aircraft, electrical, automotive, boat, and chemical fields, with a final chapter rounding up miscellaneous applications. While there are some properties charts scattered through the book, no attempt was made to present exhaustive properties information on the important materials.

Thermal properties. "Investigation of Thermal Properties of Plastic Laminates, Cores, and Sandwich Panels. Part 2." Includes specific heat from 100 to 600° F., thermal conductivity, and coefficient of linear thermal expansion from 100 to 600° F. Handbook PB 121191. Price: $2.00. 79 pages. *OTS, U. S. Department of Commerce, Washington 25, D. C.*

Vinyl movie. "Washable Family Room." Eight-min., 16 mm. film shows use of vinyl fabrics in the home. On loan to TV stations, women's clubs, church groups, and civic organizations. *Vinyl Fabrics Institute, 65 E. 55th St., New York 22, N. Y.*

Resin processing. Series of bulletins gives background information on molding, extruding, and calendering of Cycolac thermoplastic resin, including size and make of machine used for injection molding, number of cavities, cylinder temperatures, pressure, and overall time cycle for molding conditions, etc. Each 4 pages. *Marbon Chemical, Div. of Borg-Warner, 7165 Chicago Ave., Gary, Ind.*

Inserts. Technical data on H-Series Tap-Lok inserts with Class 3B internal threads, especially designed for aircraft applications. *Groov-Pin Corp., 1125 Hendricks Causeway, Ridgefield, N. J.*

Hydrogen peroxide. "How to Handle Hydrogen Peroxide" and "How to Test Hydrogen Peroxide." Each 1 page. *Becco Chemical Div., Food Machinery & Chemical Corp., 34 Sawyer Ave., Station B, Buffalo 7, N. Y.*

Thermoforming molds. Techniques of making molds and forms for vacuum forming plastic sheet materials using Hydrocal and Ultracal gypsum cements. Numerous photographs and illus-

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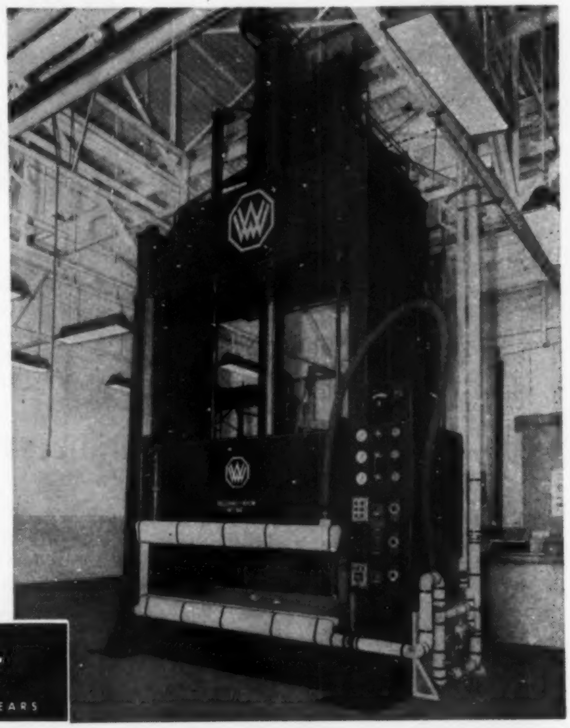

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Chemical Statistics Handbook. Statistical Summary No. 2, a supplement to the "Chemical Statistics Handbook" of 1955, with data on wage, hour, employment, production, and price trends in the chemical industry as compared with all manufacturing through the first six months of 1957. Includes chemical data from 1954 Census of Manufacturers. Price: $1.00. (Handbook, $3.00). 72 pages. *Manufacturing Chemists' Assn., Inc., 1625 Eye St., N. W., Washington 6, D. C.*

Extruded plastics. Information on complex shapes, rods, tubes, and moldings; fabricated parts; material properties; and applications. 12 pages. *Anchor Plastics Co., Inc., 36-36 36th St., Long Island City 6, N. Y.*

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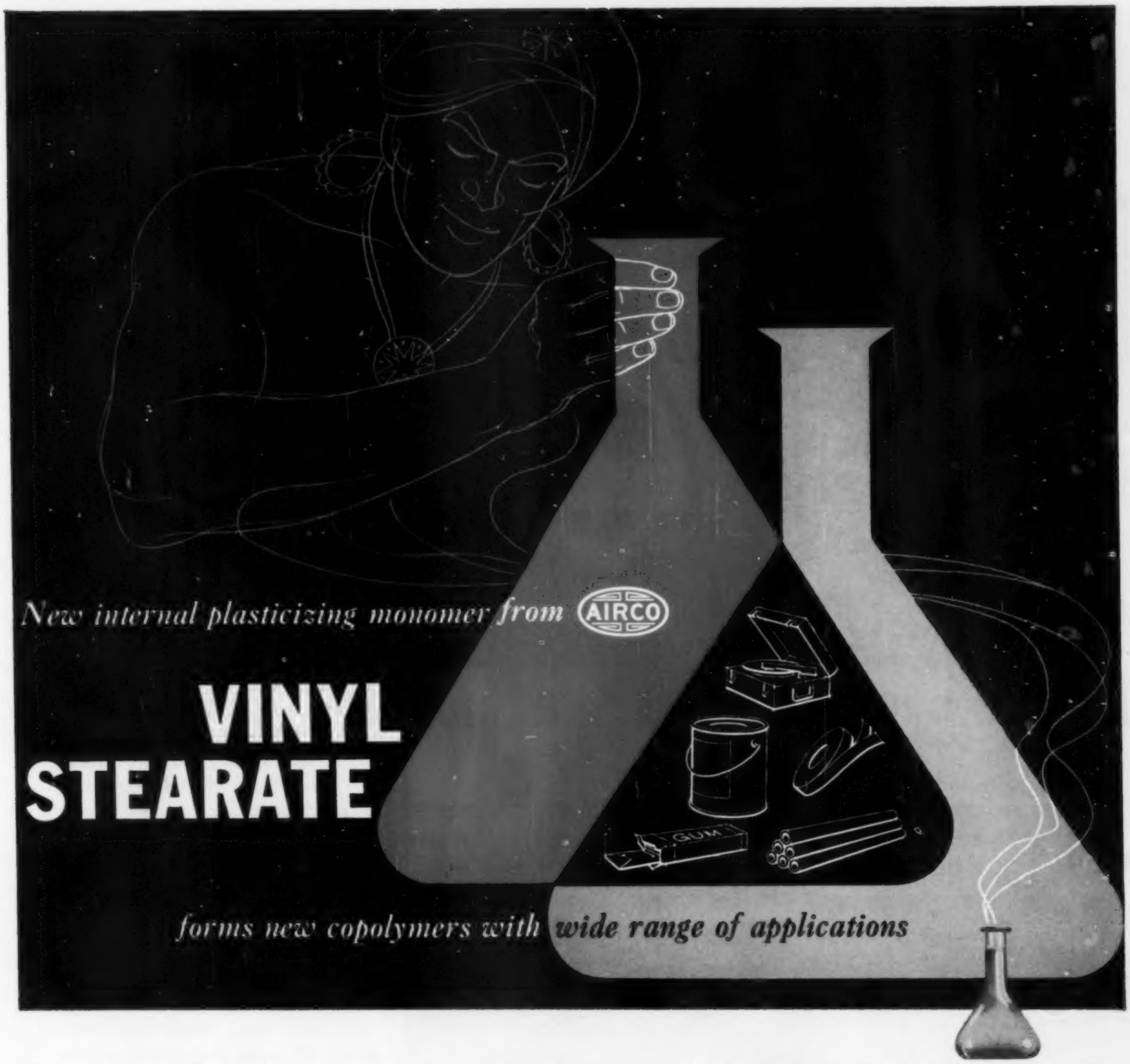

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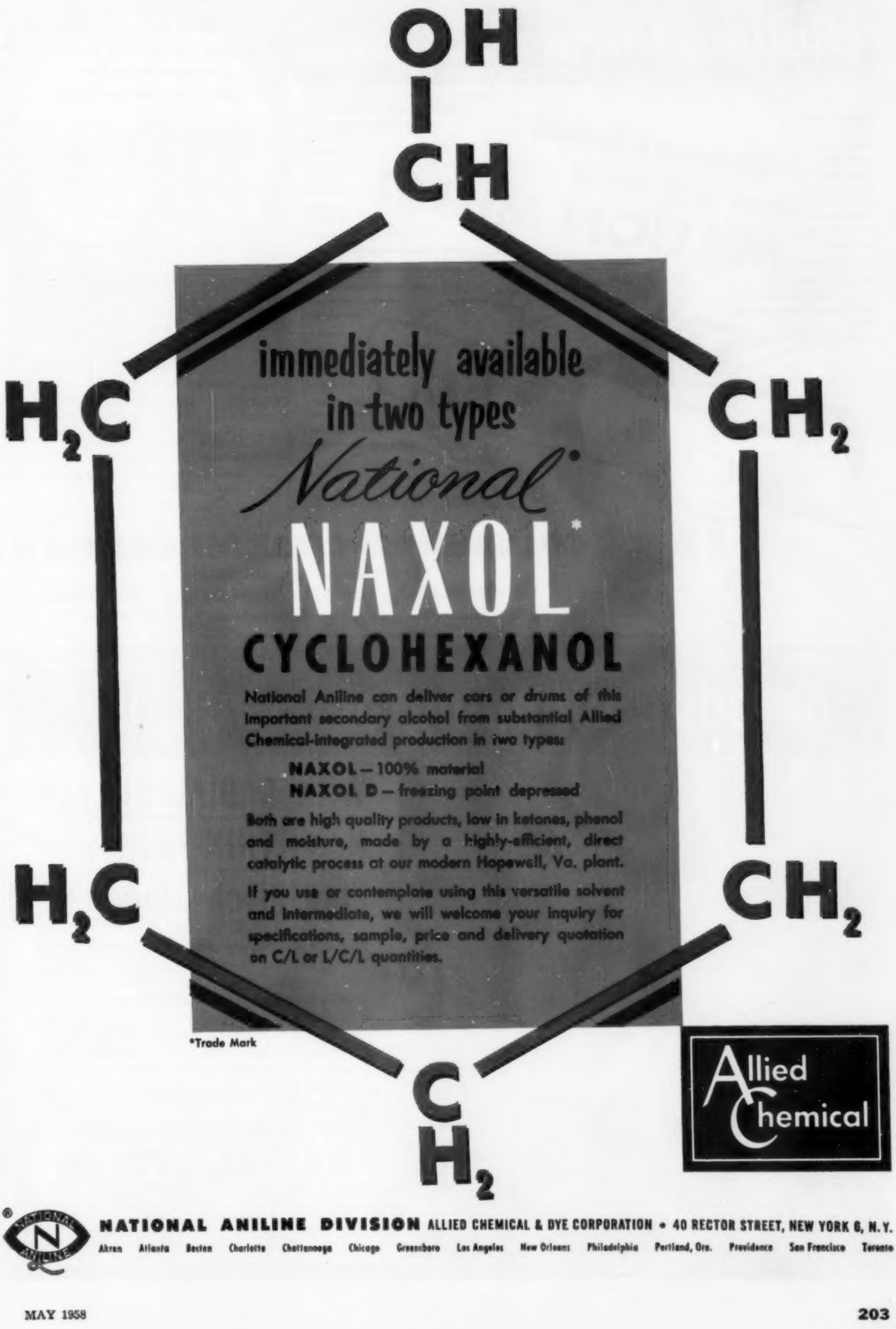

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Mold temperature control. "The What and Why of Thermolator Mold Temperature Control." Advantages, descriptions, current uses, etc. 6 pages. *Industrial Mfg. Corp., 31 E. Georgia St., Indianapolis 4, Ind.*

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Custom-molded Teflon. Suggested end uses and illustrations of custom molded parts of Teflon designed through this new process—cup, ball, or shaft seals;

washers; gaskets; and diaphragms. 4 pages. *Sparta Mfg. Co., Div. of U. S. Ceramic Tile Co., Dover, Ohio.*

Mechanical mixer. Describes new design of mechanical mixer for dry materials and tells how the machine quick-mixes any number of dry materials in any proportion by processional motion of a revolving screw flight. Six models are described. Catalog 382. 4 pages. *Blaw-Knox Co., Buflovak Equipment Div., 1543 Fillmore Ave., Buffalo 11, N. Y.*

Toxicity of plastics. "Report of the 'Toxicity' Sub-Committee of The British Plastics Federation" suggests a basis for voluntary standards for plastics coming into contact with foodstuffs. Publication No. 40. Price: 5 s. 22 pages. *BPF, 47-48 Piccadilly, London, W1, England.*

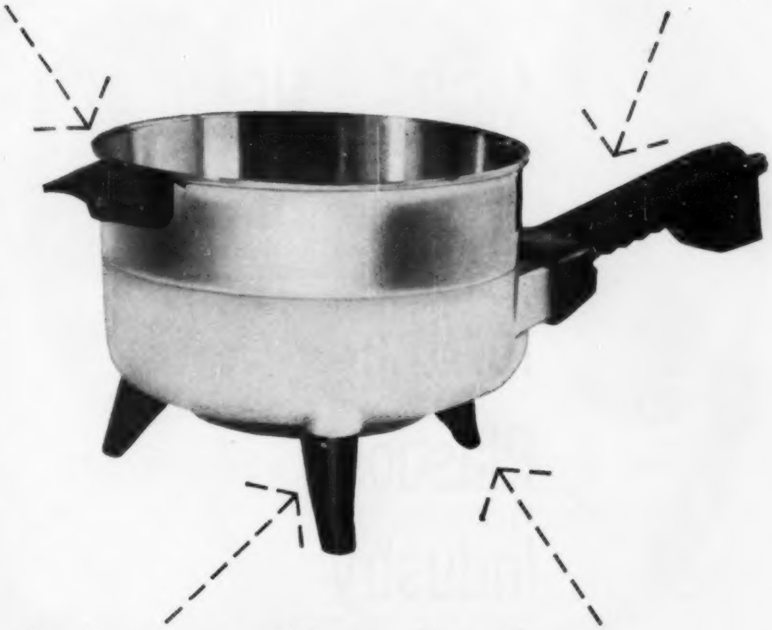
Synthetic resin coating. Functional characteristics; typical applications; moisture, weather, impact and temperature resistance; aging properties; limitations; etc. for Mono-Seal, a balanced chemosetting synthetic resin coating. 14 pages. *Mono-Seal Products, 44 Garden St., Everett 49, Mass.*

Thermoplastic fabric. Properties and suggested uses of Allfab orlonacrylic fabric, including as a filler and backing material, in package design, interlining in apparel backing for vinyl in automotive upholstery, etc. 4 pages. *The Felters Co., 22 West St., Millbury, Mass.*

Extrusions. Facilities and services offered by plastics processor, including photographs of profile extrusions, gaskets, tubing, etc. 4 pages. *Yardley Plastics Co., 142 Parsons Ave., Columbus 15, Ohio.*

Resin guide. Application and physical property data on all plastics available from the company, including Kralastic, Vibrin, Marvinol, Marvibond, etc. 8 pages. *Plastics Sales Dept., Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.*

Reinforced plastics. Comparative properties, qualities, types of



reinforcement, form of reinforcement, etc. in designing with reinforced plastics. Price: 1-100, 9¢ each; 101-1000, 7¢ each; over 1000, 5¢ each. 8 pages. *Reinforced Plastics Div., The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.*

Vinyl-rubber flux. Effects of Kenflex A with vinyl resin in nitrile rubber as mutual solvent and flux. Includes a table of compounds evaluated with nitrile rubber. 6 pages. *Kenrich Corp., 57-02 48th St., Maspeth 78, N. Y.*

Double-acting cylinders. Technical data on new line of 2000 p.s.i. double-acting hydraulic cylinders, including foot lug, center lug, front flange, rear flange, and clevis mounting cylinders for users of straight-line power. Bulletin 71000. 8 pages. *The Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis.*

Polyether flexible foams. Fundamental data on the formulation, preparation, and curing of polyether flexible foams, together with a summary of the properties and performance of the resulting products. Bulletin 11058. 6 pages. *National Aniline Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.*

Teflon tapes. Data sheet for Tem-R-Tape pressure-sensitive Teflon tape and thermal curing, and pressure-sensitive, Teflon-impregnated fibrous glass tapes. 2 pages. *The Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.*

Wire and cable. Descriptive information and operating specifications for Turbo wire and cable, including the various multi-conductor cables, silicone rubber insulated wires, vinyl tubings, coaxial cables, military hookup wires, etc. Brochure TWC 57. 6 pages. *William Brand & Co., Inc., Willimantic, Conn.*

Clear plastics. Physical and chemical properties of six special clear plastics materials, and a coating material for emergency repairs. 6 pages. *The Homalite Corp., Wilmington 4, Del.*

Plastics

Production and sales figures in 1000 lb.* for the year 1957 and January 1958

Materials
Cellulose plastics:[a]
Cellulose acetates and mixed ester:
Sheet, under 0.003 gage
Sheet, 0.003 gage and over
All other sheets, rods, and tubes
Molding and extrusion materials
Nitrocellulose sheets, rods, and tubes
Other cellulose plastics
Phenolic and other tar-acid resins:
Molding Materials[a]
Bonding and adhesive resins for:
Laminating (except plywood)
Coated and bonded abrasives
Thermal insulation
Plywood
All other bonding uses¶
Protective coating resins
Resins for all other uses
Urea and melamine resins:
Textile-treating resins
Paper-treating resins
Bonding and adhesive resins for:
Plywood
All other bonding and adhesive uses, including laminating
Protective-coating resins
Resins for all other uses, including molding
Styrene Resins:
Molding materials[a]
Protective-coating resins
Resins for all other uses
Vinyl resins, total[b]
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:
Film (resin content)
Sheeting (resin content)
Molding and extrusion (resin content)
Textile and paper treating and coating (resin content)
Flooring (resin content)
Protective coatings (resin content)
All other uses (except resin content)
All other vinyl resins for:
Adhesives (resin content)
All other uses (resin content)
Coumarone-indene and petroleum polymer resins
Polyester resins
Polyethylene resins
Miscellaneous:
Molding materials[a, d]
Protective-coating resins[e]
Resins for all other uses[f]

*Dry basis designated unless otherwise specified. †Revised. ‡Partially estimated. ¶Includes friction materials. [a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

Preliminary totals, 1957†		January 1958‡	
Production	Sales	Production	Sales
18,568	18,030	1,289	1,214
18,448	17,917	1,499	1,199
7,573	7,236	635	557
94,193	93,022	6,138	6,433
3,972	4,114	348	376
5,358	4,738	874	693
184,243	177,103	15,637	13,003
59,328	46,546	4,997	3,220
16,788	16,555	1,248	916
51,847	51,824	4,346	3,686
46,110	36,213	4,069	3,547
57,873	55,758	5,335	4,593
29,949	24,791	2,292	2,092
36,745	30,708	2,648	1,996
35,995	34,668	3,177	3,032
24,324	22,890	1,661	1,800
96,266	93,367	7,558	6,817
33,362	30,890	2,862	2,639
36,441	27,430	2,616	1,926
89,196	90,547	8,951	8,915
415,044	399,702	28,550	31,596
83,926	78,070	7,690	7,233
146,757	120,979	13,085	10,685
829,985	747,017	68,975	58,895
	73,573		5,870
	56,525		4,119
	215,023		16,361
	66,447		4,035
	81,376		7,562
	31,520		2,885
	67,674		4,071
	41,883		3,212
	112,996		10,780
251,018	249,519	18,519	18,506
91,182	83,092	7,260	6,594
694,487	650,481	69,522	62,631
48,855	48,008	3,522	3,652
13,217	6,364	1,076	641
134,205	116,695	10,885	8,983

are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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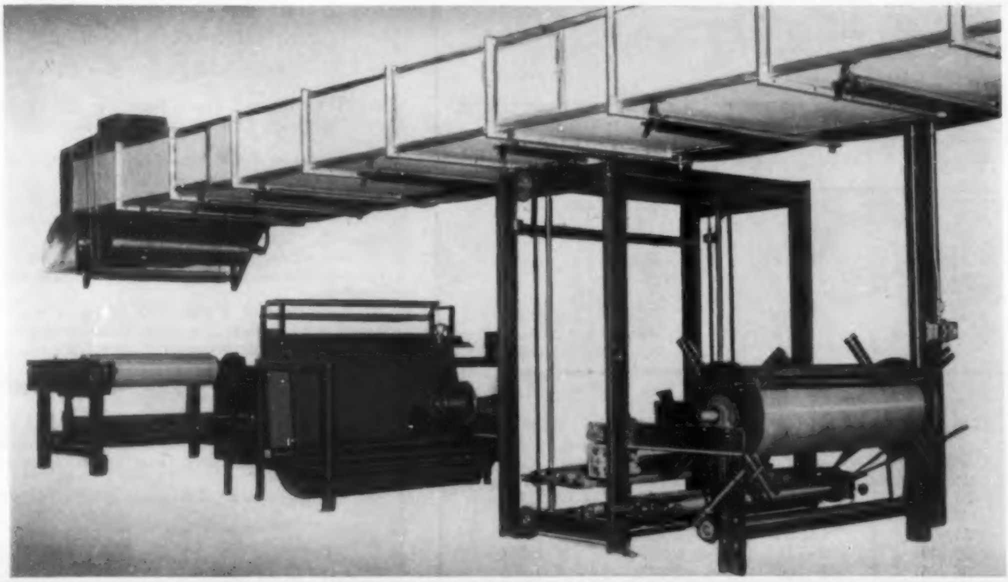

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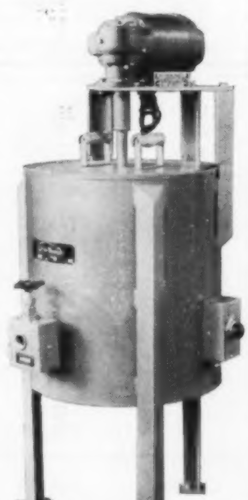

This Sta-Warm plastic melter, model Y, with selective temperature control, heated gate valve and power driven agitator makes simple work of melting a wide variety of thermo-plastics *economically, uniformly, dependably.*

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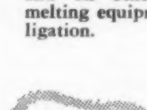

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Subsidiary of ABRASIVE & METAL PRODUCTS CO.

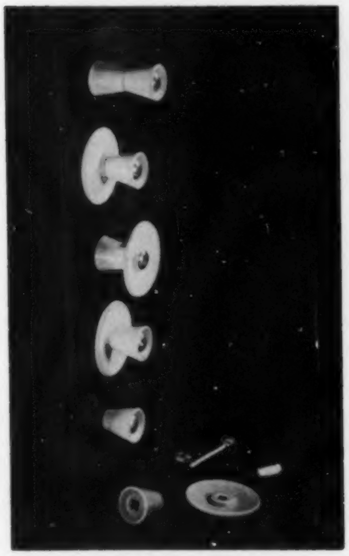
Versatile urea knob

With two basic molded urea shapes, five completely different knobs can be put together for use in the home. The two shapes include a reverse-taper pull and a concave plate. They are available in black, white, yellow, turquoise, and high-gloss red. By permutation of these colors, additional effects can also be achieved.

Urea was chosen for this versatile knob because of its color permanence and resistance to heat and common household chemicals. Applications include drawers, cabinets, ranges, appliances, and utensils, to all of which they gave a cheerful, modern touch.

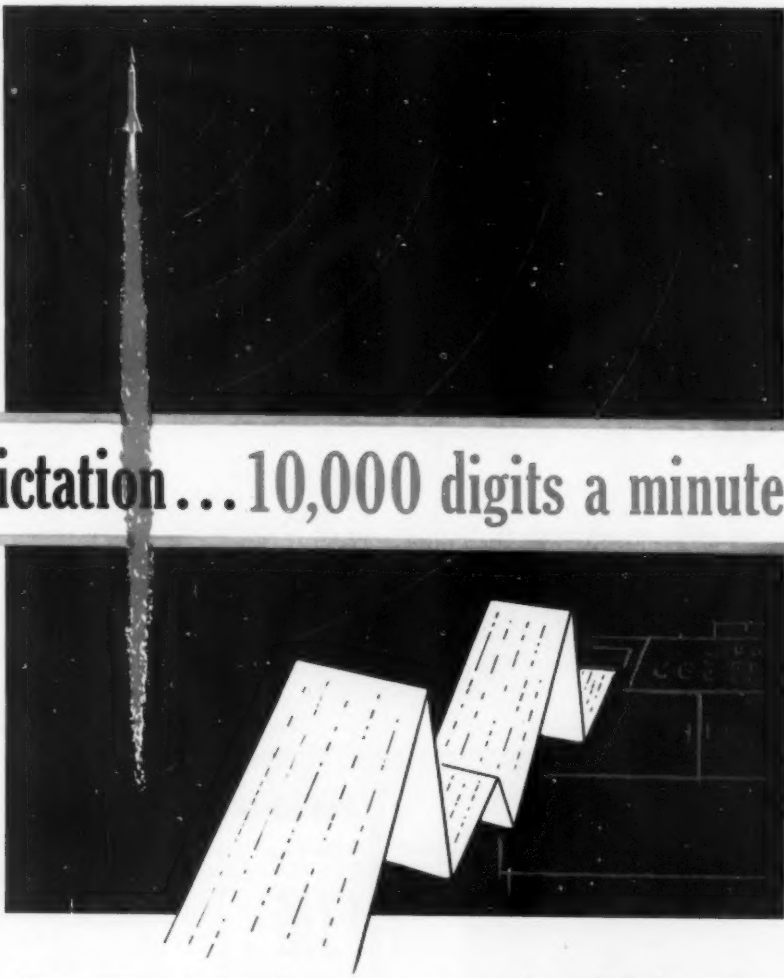
With the two basic pieces and the five different colors the design of knobs may be changed after they have been in use for some time, to give a new look to familiar furnishings.

Credits: Manufactured by Westmoreland Plastics Co., 131 Gertrude St., Latrobe, Pa., of Plaskon urea supplied by the Barrett Div. of the Allied Chemical Corp.



Two basic urea moldings can be used in different arrangements to make five different knobs for use on furniture and other household goods. Knobs at left are arranged vertically on dark background. (Photo, Allied Chemical Corp.)

Solving unusual problems with Riegel papers



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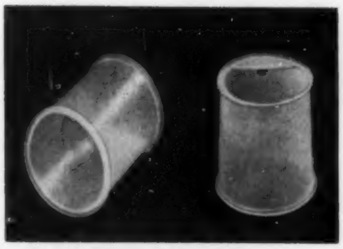


Injection molded polyethylene fitment for tight-head drums reduces spout costs, is easily used

Disposable spout

Spillage and dripping problems generally associated with the decanting of liquids from drums and covered pails can be reduced to a minimum or entirely eliminated with the use of a recently developed fitment injection molded of polyethylene.

Designated Insert-O-Spout, the device is $1\frac{7}{8}$ in. long and designed for use on tight-head drums or open-head pails having a 2-in. screw cap opening. No tools are required to insert the spout into the opening—since the spout is flexible, it is simply pushed in.

When not in use, the entire length of the unit extends into the interior of the container, permitting the screw cap to fit over it and making it possible to ship the drums with the spout already in place.

Flanges molded around the top and bottom rim of the spout prevent it from slipping out of or into the container. To use the spout, it is pulled out of the container as far as the flange will allow and then the liquid can be poured.

When no longer needed, it is pushed back into the container as far as the top flange will allow, and the screw cap is put on. A molded-in lip in the top of the spout assures a well directed flow of material. The fact that the spout extends almost 2 in. from the drum when in use holds spillage down.

Credits: Molded by Angier Adhesives, Div. of Interchemical Corp., 120 Potter St., Cambridge 42, Mass., of Du Pont Alathon polyethylene.

Drawing for the blind

Latest application of plastics in the service of the blind is a drawing kit which makes it possible to produce raised lines that are easily traced by finger. Key to this system of reproduction is 1-mil Mylar polyester film, on which the raised lines are produced.

To make a drawing, a sheet of Mylar film is clamped to a rubber-surfaced writing pad. Firm writing pressure with an inkless ball-point "pen" results in a series of tiny bumps, which appear as raised lines on the upper surface of the film, and which are very distinct to the touch.

In addition to the clear, positive drawings made possible by this method, the use of Mylar film contributes an additional and important advantage: it permits indefinite storage of drawings, since the film does not become brittle or otherwise deteriorate with age.

The kits are finding use in geometry work, in making graphs, in drawing electrical circuit diagrams, in the preparation of maps, etc. They come complete with drawing pad, pen, and 70 sheets of Mylar. Price is about $4.00.

Various other techniques have been tried in the past for this purpose. But in almost all cases the raised lines appeared on the underside of the film material that was used, resulting in hard-to-read reverse drawings.

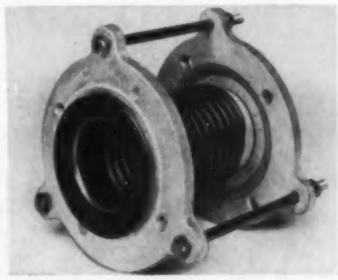
Credits: Developed and manufactured by The Sewell Co., 41-25 58th St., Woodside 77, N. Y.; distributed by American Foundation for the Blind, Inc.; Mylar polyester film by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Teflon bellows

A complete line of molded Teflon bellows said to have twice the burst strength and 20 times the flex life of conventional bellows machined from cylinders is manufactured by Resistoflex Corp., Roseland, N. J. In molding rather than fabricating the product, a high-density compound is used instead of the conventional material.

Dynamic working pressures as high as 120 p.s.i., full vacuum service, and bending deflection up to 70° and axial movement to 2 in. or greater are claimed for the new bellows.

The bellows are designed to compensate for expansion and contraction, misalignment and vibration in piping systems, reaction vessels, pumps, valves, towers, storage tanks and other applications where corrosive environments combined with high temperatures are, likewise, a problem.



Teflon bellows are molded to maintain linear orientation throughout convolutions, to provide optimum tensile strength and fatigue life. (Photo, Resistoflex)

Temperature resistance of the bellows is 450° F. They are said to provide complete corrosion-proofness, since they are completely unaffected by all chemicals except molten alkali metals and fluorine at elevated temperatures and pressures. The bellows are non-aging, non-contaminating, and inhibit build-up of deposits because of their non-adhesive characteristics.

Credit: Teflon fluorocarbon resin by Du Pont.

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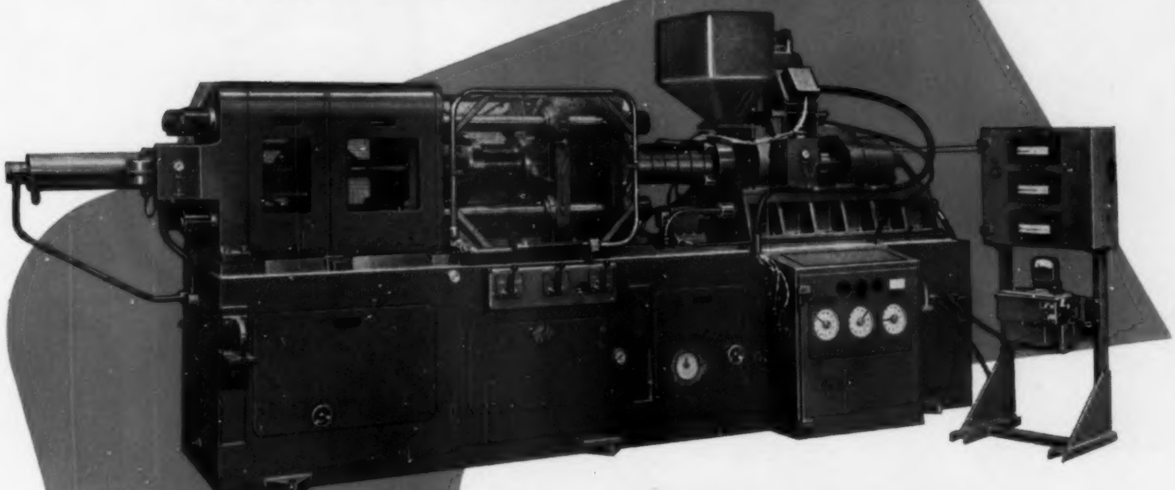

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Large platen area
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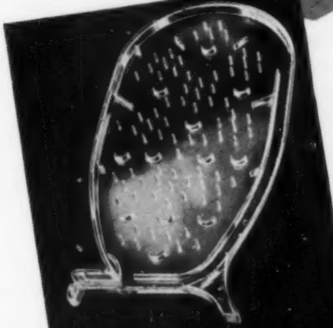
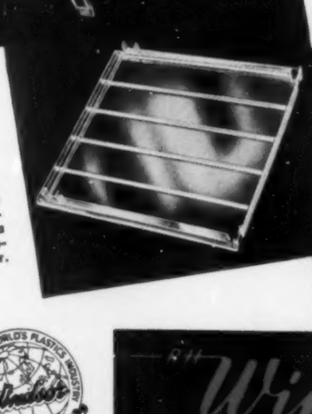
★ 44 cubic inch capacity, equal to approximately 26 oz. of Polystyrene
★ Dependent on mould construction and materials



BAGATELLE BOARD

Large area Bagatelle Board weighing 15 ounces approx. in polystyrene with a time cycle of approx. 80 per hour.



REFRIGERATOR SHELF

Medium area refrigerator shelf weighing 14 ounces in polystyrene with a time cycle of approx. 60 per hour.

BATHROOM SCALE

Medium area, heavy section weighing machine platform weighing approx. 22 ounces in high impact polystyrene with a time cycle of approx. 60 per hour.

★ The Windsor range includes INJECTION MOULDING MACHINES in capacities of from 1 to 200 ounces and EXTRUSION MACHINES with outputs up to 500 lbs. per hour.

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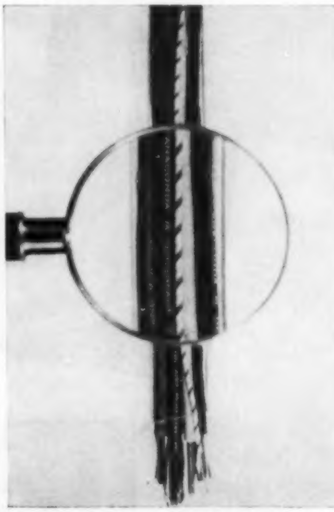
Clear vinyl tubing

New crystal clear vinyl tubing for a variety of electrical applications has been developed by Irvington Div. of Minnesota Mining & Manufacturing Co., Irvington, N. J. The product is reported to have none of the off-shade amber or green coloration often associated with clear vinyl formulations.

Because of the transparency of the new tubing, it has already been used extensively in aircraft electrical harnessing and many similar applications where a clear, low temperature tubing is required.

The new tubing has a low temperature A.S.T.M. brittle point of $-100°$ F. Dielectric strength is 300 v./mil, tensile strength is 2000 p.s.i., elongation is 300%, and moisture absorption is very low. The resistance of the tubing to ultra-violet rays is described as excellent. It will not corrode when in contact with copper or aluminum and it is also self-extinguishing in less than 15 sec., which is the standard requirement for use with aircraft. Maximum operating temperature for continuous service is 185° F.

The clear tubing is available in standard coil lengths in sizes ranging from #24 up through 3 in. inside diameter.



Printing and color-coding can be read easily through clear vinyl tubing for electrical use. (Photo, 3M)

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higher injection rapidity

SPECIFICATIONS

model	NB 28	NB 30 Record	NB 40	NB 60 E	NB 100	NB 120 E	NB 160
injection capacity oz.	1	1 1/4	1.4	2.1	3.5	4.2	5.6
hourly plasticizing capacity lbs.	6.6	12	15.4	28.6	26.4	53	39.6

			FULLY AUTOMATIC				
model	NB 220 E	NB 360/520 E	R 01	R 02	R 6 FA	R 12 FA	R 20 FA
injection capacity oz.	7.7	13-19	0.53	0.85	2-3	4-6	7.7-11.6
hourly plasticizing capacity lbs.	75	97	7.7	7.7	29	53	75

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Tomorrow's packages

(*From pp.* 95-101)

supplied by Minnesota Mining & Mfg. Co., on the other hand, offers a resistance to heat and chemicals impossible to find in other plastics. One of the first applications for this film in the packaging field was a sterilizable suture tube. The sutures, manufactured by J. A. Deknatel & Sons, Inc., Queens Village, N. Y., are supplied to hospitals in individual packages.

Polypropylene film, another new product looming on the packaging horizon, is transparent, exceptionally impermeable to a wide variety of vapors and gases, has higher heat resistance than polyethylene film, and can be heat-sealed on conventional equipment used to seal polyethylene.

Polyvinyl alcohol film offers package engineers the unique feature of a material that is soluble in water. Unit packages of detergents or bath salts, for example, packed in this film need not be opened, but can be simply dropped into the water where they dissolve in a few seconds.

Polyester film, now being supplied in three different forms by three different manufacturers, is also moving into prime contention in the film packaging field.

Shrinkable polyester film, for example, made by orienting the film during manufacture, enables poultry packers and suppliers of meat products to turn out neat, form-fitting packages combining excellent protection and eye-appeal. In 1957, Du Pont announced the availability of a heat-shrinkable Mylar film and recently, Goodyear also announced that they would shortly be making available in limited quantities heat-sealable, heat-shrinkable Videne TC film. The polyester films, in addition to their exceptional strength over extremes of temperature and humidity and their impermeability to water vapor and gases, are so designed that they shrink instantly and uniformly when subjected to heat in the form of a fast in-and-out hot water dip or exposure to steam. Wilson & Co., Inc., is already using Mylar heat-shrinkable film for packaging boneless hams.

Polyester film laminated to

polyethylene film is also playing a leading role in the concept of "boil-in-the-bag" packages. Refrigerated or pre-cooked frozen food products in packages of this type can be dropped directly into boiling water (without removing the contents from the bag).

In a totally different type of application, heat-sealable Scotchpak polyester film, a product of Minnesota Mining & Mfg. Co., solved a packaging problem for Purex Corp., Los Angeles, Calif. The 2½-mil film was found to combine the high strength, the ability to be heat-sealed, and the low transmission rates for water, alcohol, and essential oils required to package sample packets of a liquid detergent. Printed with a six-color flexographic reproduction, the film was supplied in roll form to William Bishop Co., Burbank, Calif., where a standard Brown machine was used to form and fill two of the single-use packets at a time.

Using the same type of Scotchpak film, Johnson's Products Co., San Francisco, Calif., developed a self-dispensing package for its caulking compound.

Injection molded packages

In recent years, injection molded plastics packages have had a tremendous impact on the merchandising of food and non-food products. The color range and transparency possible with such packages contribute excellent merchandising appeal while the fact that many plastics can be used in direct contact with food products opens up vast marketing opportunities.

Probably the greatest obstacle thus far to larger volume use of molded containers is the high tool cost (especially for custom designed packages) and their relatively high finished cost. Factors which will, it is hoped, eventually shrink this differential include lower raw materials costs and faster, more highly automated molding cycles. Thin-walled 7-oz. styrene cups for use in a vending machine and a 9-oz. styrene throw-away cup, for example, are already considered as competitive with paper cups. Styrene baskets for strawberries, requiring relatively little molding material be-

cause of their open-lattice design, are another example of what is being done to cut down costs.

Package engineers are also discovering that the design potential inherent in plastics permits cost economies in assembly, incorporation of dispensing features, and one-piece design. Polyethylene packages, for example, can be molded with a self-hinge construction that eliminates assembly of a separate body and cover. The adaptability of plastics to "built-in" features is also evident in two molded self-dispensing containers for lotion-type deodorants recently introduced by Helene Curtis Industries, Inc., and The Toni Co. Both packages have exterior tube sections molded of high-impact styrene and used with a rotatable base and an internal polyethylene "elevator."

Injection molded aerosol-type containers for such products as cologne also show potential in the packaging field. One such container, under experimental development by National Plastics Products Co., Odenton, Md., is molded in two sections of Zytel 101 (Du Pont), making a two-toned color effect possible. These sections are joined by spin-welding. Delrin acetal resins have also been suggested for the 320-million unit aerosol market.

Compression molded packages

At present, the number of packages produced by compression molding is relatively small, probably because the relatively slow molding cycles are not adaptable to the high-speed production necessary for packaging. Except for the rather limited use of urea and melamine for some types of cosmetic containers and decorative boxes for jewelry, the thermosets are rarely encountered in commercial packaging.

There has, however, been some use of heavy-duty molded phenolic containers for tools and related hardware items, in which the package doubles as a permanent storage unit for the product. There has also been considerable interest in the possibilities of thermoset aerosols. In 1955, an aerosol molded of American Cyanamid's melamine by Colt's Plastics Co., Inc., North Grosven-

ordale, Conn., was introduced for Angelique cologne. Adequate strength to withstand internal pressures, attractive color possibilities, and chemical resistance were some of the factors influencing the choice of melamine. More recently, these packages have also been made available with an eye-catching metallized finish.

Bottles and tubes

The growth of blow-molded bottles and extrusion-fabricated packages has been nothing short of phenomenal.

The rocketing growth of polyethylene squeeze bottles and the closely related polyethylene tubes and metal-end type cans stems from a combination of light weight, reduced shipping costs, virtual freedom from breakage, a wide range of colors and designs, and the ability to contain a great variety of food products, cosmetics, adhesives, and other substances. Although polyethylene's permeability to some products has been a limitation up to now, this obstacle is being rapidly erased through the use of new types of internal and external coatings, and new formulations offering an increased range of properties.

One of the biggest advances in this direction was made last year with the introduction of a Plax polyethylene squeeze bottle for Ipana toothpaste—a revolutionary concept in dentifrice packaging. An interior coating makes this product the first squeeze bottle able to retain the aromatic oils in toothpaste, which may spark important strides in this direction.

Although polyethylene now dominates this market, it is conceivable that other types of thermoplastics may soon come into contention, including elastomeric vinyl and extrusion formulations of nylon. It is interesting to note that nylon (*Zytel 42*, Du Pont) was used in the first blow-molded plastic aerosol container to reach the market. The aerosol was produced by Imco Container Corp., Kansas City, Mo., and was used for Park & Tilford's Sta-Put hair spray. The aerosol is light in weight, attractive, and shatterproof. Permeability is no problem and the container has an added advantage in affording the con-

sumer visibility through the translucent thin walls.

As far as costs of a nylon aerosol are concerned, it is estimated that a Boston round-type bottle can be produced for 12¢ in vinyl-coated glass and 16¢ in nylon. On a cost-delivered basis, however, the picture changes. The nylon weighs only 1/6 as much as its glass counterpart, can be scramble packed, does not break or chip in transit, and resists breakage during filling. In addition, the nylon container offers much more flexibility in designing wall shapes to add strength or beauty.

The possible use of linear polyethylene for blow-molded aerosol containers is also under study, but no containers have reached the market at this writing.

Extruded packages

This type of package, most frequently extruded of acetate or butyrate (although polyethylene and vinyl are also used in smaller quantities), offers an excellent combination of visibility, product protection, and low unit cost. Typical products now sold in large volume in such packages include toothbrushes, drill bits, nails, nuts, bolts and other small machine screw parts, and even soft goods such as stretch socks.

These packages generally consist of an extruded body of tubular, oval, or rectangular section, cut to the required length and fitted with a formed base of the same material. Closures range from threaded metal types to slip-on caps formed from sheet stock. One advantage of this type of package is that the same extruded section can be used to package a wide range of different product sizes. The tube also accepts printing well for product identification. And as far as costs are concerned, *Modern Packaging Encyclopedia* reports that containers with 1-in. interior diameters and 2½-in. long, complete with seals, caps, and two-color label, costs less than 1½ cents.

Cellular plastics

Packages molded or fabricated of rigid cellular plastics offer a number of unique properties—very light weight, built-in cushioning, and excellent thermal in-

sulating characteristics. Form-fitting cavities molded or fabricated directly in the cellular containers support and protect the packaged products.

Expandable styrene, in the form of pre-expanded beads, is coming into increasing use for producing packages of this type.

Products already being packaged in molded styrene foam include glass figurines; delicate glass stemware; electronic parts; home barber kits; and vials for blood, antibiotics, and other pharmaceutical products. Packages molded of the beads have a closed cell structure, providing high strength and a non-dusting, non-scratching surface.

A manufacturer of stainless steel tableware who adopted a molded styrene foam package to replace a paper set-up box based his decision on the light weight of the plastic package, its greatly increased sales appeal (in color), its plus value as a re-use tray in the home, where it could be washed and exposed to foods without damage, and the fact that its relatively soft surface made it quiet in use. The container is molded by Ambassador Plastics & Mfg. Corp., Chicago, Ill.

Other types of plastics foams which certainly have application in the packaging field include vinyl and urethane. The military, for example, has been experimenting with foamed-in-place packaging in which urethane chemicals are foamed directly around items such as vacuum tubes and similar fragile articles. The adaptability of this type of packaging for various consumer and industrial products is obvious.

A look to the future

Plastics packaging is a field in which new developments come thick and fast. Basic materials are under constant study and improvement, as is the equipment used to produce plastics packages and handle them efficiently. And more interest can be expected in the future—particularly as the cost of plastics decrease, while costs for most other packaging materials increase.

Out of these efforts, on so many fronts, will emerge "tomorrow's plastics packages."—END.

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DESIGNING NYLON PRODUCTS. 28-page manual discusses engineering design principles involved in developing product applications for nylon resins. Gives data on application of nylon's physical and chemical properties to design calculations. E. I. du Pont de Nemours & Co. (E-808)

DIETHYLENE GLYCOL. 4-page bulletin tabulates properties and specifications of this stable non-volatile, colorless liquid, and discusses its use in the manufacture of resins, plasticizers, adhesives. Nitrogen Div., Allied Chemical & Dye Corp. (E-809)

CASTING AND IMPREGNATING TECHNIQUE. 48-page illustrated catalog on vacuum impregnation equipment describes its application for mold casting, insert casting, and resin impregnation. NRC Equipment Corp. (E-810)

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STABILIZERS. Technical bulletin outlines general characteristics, typical properties and recommended uses in vinyl electrical insulation of a lead-chlorophthalo-silicate stabilizer. National Lead Co. (E-822)

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CYLINDER LINERS. 16-page brochure is an engineering and data guide to "Xaloy" bi-metallic extruder cylinders. Contains technical specifications and comparative strengths of internally lined tubing. Industrial Research Laboratories. (E-826)

NOZZLES FOR INJECTION MACHINES. 48-page catalog describes, presents pictures, diagrams, specifications, dimensions and prices of extensive line of replacement and special purpose injection machine nozzles and such accessories as nozzle controllers, thermocouples and heater bands. Injection Molders Supply Co. (E-827)

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PLASTICIZERS. Technical bulletin presents test data on vinyl compositions, plasticized with various Oxo alcohol esters with specific reference to stabilization against oxidation, color degradation and retention of physical properties under accelerated aging conditions. Enjay Co. (E-830)

STYRENE. 6-page folder tabulates the comparative properties of this firm's series of styrene and acrylonitrile-styrene molding compounds. Includes data on recommended uses for each formulation and describes the granulations in which each is available. Catalin Corporation of America. (E-831)

TOOL STEELS. 12-page pamphlet discusses the manufacture of tool steels for plastic molds, analyzes factors involved in mold steel selection, and presents information on mold design, polishing and heat treatment. Crucible Steel Co. (E-832)

COLORS FOR VINYLS. 9-page technical bulletin describes firm's "D" series of calibrated color pastes for vinyl compounding. Gives tabular test data on their heat and light stability, coloring strength and chemical resistance. Price list included. Claremont Pigment Dispersion Corp. (E-833)

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HYDRAULIC PRESSES. 12-page catalog describes construction features and contains specifications for a line of 30 to 500 ton compression and transfer presses, and from 300 to 5,000 ton hobbing presses, and of accessory hydraulic pumps, accumulators and controls. Elmes Engineering Div., American Steel Foundries. (E-839)

AUTOMATIC COMPRESSION PRESSES. Illustrated 12-page catalog describes features and gives specifications on line of 50, 75, 125, and 200-ton fully automatic compression molding presses with platen areas up to 30 x 24 inches and cycling speeds ranging from 8 to 11 seconds. F. J. Stokes Corp. (E-840)

POLYVINYL ALCOHOL. 20-page catalog describes properties and uses of a line of polyvinyl alcohol resins, includes tabulations of available grades, their properties, selected reactions, and gives data on their uses as emulsions, adhesives, films, and molding materials. Shawinigan Resins Corp. (E-841)

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Automatic control

(*From pp.* 133-136)

the resin content must vary from the target resin content before the controller will do anything about it. This provision reduces hunting and unnecesary control actions. A second adjustable element is an excesive-error safety which operates to discontinue control action and to sound an alarm when the control action called for is excessively large. This protects against the consequences of malfunction of the process equipment or beta-ray gages. A third adjustable element is the proportionality control, which determines the size of the control action which a given error signal will initiate. This permits easy adaptation to even very large differences between the products made on the treating machine.

By manually inserting a signal voltage instead of the error voltage developed by the beta-ray-gage computer, the operator can change squeeze roll settings at will from his station, which is 100 ft. from the squeeze-roll stand. This feature is used when the beta-ray gages are not operating, as is the case before a run is started. This operation, termed "semi-automatic," is accomplished by throwing a switch, setting a potentiometer for the direction and size of control action desired, and pressing the appropriate push-button. Manual operation of the squeeze-roll positioning motors at the calender stand is also possible. This is done by switching out the controller panel and pressing the appropriate push-buttons located at the motors.

This set-up demonstrates the stepwise development of most automation—first the process, then the measurement, and finally the automatic control. It represents a synthesis of knowledge concerning the laminate manufacturing process, beta-ray gaging and control theory, and mechanisms. It has performed so well for the user that two more such units, which were built by the General Electric Industry Controls Department, have recently been installed.—END.

Machining TFE

(From pp. 123-132)

trades, it is common to see one operator tending three to six machines. In plastics, this is reduced to one operator for each two to four automatic machines, depending on the tolerance required and the material worked. Machining TFE to tolerances down to ± 1 mil or less requires a first-class operator working one, or at best, three machines, *after* initial runs reveal no off-spec parts. At Tri-Point, when $\pm$ 1-mil tolerances are required in a part, the operator looks for reasons in either the material or technique when dimensions start to drift by 0.25 to 0.5 mil. In production lots no more than 1 to 2% out-of-spec material is allowed. Indications of higher percentages usually show up clearly when the initial run is made on the hand screw machine and again when the operation is transferred to the automatic screw machine. During full-production machining, careful checks of tolerances are made on from 10 to 100% of the parts machined, depending on the type of part machined.

After primary and secondary machining operations are completed, parts are cleaned and deburred and the entire production run checked visually for finish and tolerance rejects again. This phase of operation is carried out according to Military Standard 104, a sampling inspection plan.

Designer should work with machinist

Tetrafluoroethylene resin has outstanding properties, and is especially well adapted to the electronics field where it is unexcelled.

However, its advantages can be fully realized only if the design of the individual part falls within the material's reasonable physical limits. Principles of design used with other plastics and non-plastics materials cannot be applied "across the board" when designing with TFE resin. The design engineer can save time and money and assure optimum performance of parts by getting the help of the machinist experienced in production of TFE parts. The latter can readily advise the designer when specifications are either unreasonable or unrealistic from the standpoint of the material's actual performance characteristics, or from the standpoint of impractical or uneconomical machining or subsequent fabricating operations.

Oftentimes, the objective of the original close tolerance can be achieved at lower cost by simple design modification, or by taking advantage of one or more of the material's properties.

For example, an extremely close tolerance of a half or a quarter of a mil may be specified on an O.D. so that the part will fit snugly into another part. With very few exceptions, it is found both less expensive and more effective to machine the part in question a thousandth or so *oversize.* The elasticity of TFE resin will allow its ready insertion, with the material expanding to give a good grip. This line of

thinking is used with good results where there is a great difference in thermal expansion coefficients between the plastic and perhaps a metal chassis. An application of this principle is our sub-miniature "Trinseels" terminals (see photo on p. 123) used extensively in the electronics industry.

When thin sections are under load, the plastic may extrude or flow out, defeating the original intent of the designer. It may then be necessary to modify either the plastics part's design or that of the structure in which it will be used.

Standard commercial tolerances (± 5 mils/in.) can be specified and obtained readily. Where possible, these should be kept in mind when designing a part. Going from standard to closer tolerances of perhaps ± 3 mils/in. will bring with it increased cost of machining or fabrication. This is especially true with close tolerances or ± 1 mil and less. Tolerances closer than standard commercial can bring costs up by an additional 20 to 50 percent. Whether such tolerances, with their higher additional costs, can be justified in the application, should be carefully evaluated by the design engineer and the ultimate user. The relatively high coefficient of thermal expansion (0.06 mil/in., °F.) can easily make futile close-tolerance work.

The designer and the machinist must also keep in mind the ultimate application of the finished part when determining the actual tolerances to be specified and met during machining. TFE resin undergoes a phase transition between 65 and 77° F.; there is a change in specific volume that accompanies the transition, so dimensions machined *below* this transition point will not hold at service temperatures *above* the transition point. The reverse is also true.

A good rule of thumb to use in designing with TFE resin, where machining is involved, is to consult with the processor on any part where closer than commercial tolerances are to be required. Generally, it is profitable to get the processor's suggestions when the part is to be produced in large quantities.—END.

Portable washer

(From pp. 105-107)

fabrication of these parts of the washer.

The unusual shape and functional requirements of the five nylon parts presented the molder with a number of problems in designing the molds. For example, a flash condition could not be tolerated because of the possibility of lint collection in the agitator. The cam mold is actually barrel shaped and some shrinkage of the nylon must take place before the part can be ejected from the mold. This single-cavity mold incorporates a ring gate to provide an even flow of the nylon material into the part; both the ring gate and the barrel shape are needed to produce a finished part that is straight. Upon removal from the mold, the cam is degated and the spiral grooves which control the motion of the agitator are machined into the surface of the cam.

The agitator hub, produced in a single cavity, multiple-gated mold, weighs slightly more than 2 oz., and is reported to be one of the largest parts ever made of nylon. The molding of this oddly-shaped component is complicated by the integral cam follower tube, which runs at right angles to the central tube that fits the cam shaft. The coring of the cam follower tube is accomplished by means of a retracting side core in the mold.

The agitator sections are also produced in a single-cavity mold. This intricate part, having a curved, stepped-down design, includes 142 rectangular openings, providing a total of 426 openings in the assembled agitator through which the water and detergent solution may freely circulate as the agitator reciprocates over a $1\frac{3}{8}$-in. stroke.

Epoxy-encapsulated parts

The motor of the portable washer, including all wires and electrical connections, is completely encapsulated by General Electric Co., using its own epoxy resins. The motor stator is baked in a conveyorized oven to cure the epoxy. With the motor immersed in water and all mechanical motor seals removed to allow water to fill the inside of the motor, it is possible to energize the windings without detecting any measurable electrical leakage from the encapsulated windings. The machine was tested in this manner by Underwriters' Laboratories.

The washer involved three years of cooperative efforts by AMI, Mel Boldt & Assoc., Chicago, Ill., which handled styling of the appliance, General Electric Co., and the molders.

Credits: Phenolic base molded by Modern Plastics Corp., Benton Harbor, Mich., using Bakelite and Durez agitator-type materials. Melamine cover and handle components and phenolic impeller, Plastic Service Corp., La Porte, Ind., using American Cyanamid melamine and Durez agitator-type phenolic. Nylon cam shaft, agitator hub and agtitator sections, Michigan Plastic Products, Inc., Grand Haven, Mich., using Du Pont Zytel 101 material.

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Kaolinite

(From pp. 157-166)

resin and adding enough ethyl alcohol to give good working properties. The mix was spread over the preweighed glass mat and air dried. It was further dried at 265° F. for 10 min. in a circulating-air oven. The panels were molded at 265° F. and 250 p.s.i. for 10 minutes.

Use of a kaolinite fraction with a large amount of stacks gave the reinforced phenolic resin lower water absorption; whereas other clay fractions gave higher water absorption (Fig. 5). Relatively little change in the flexural (Fig. 6) or compressive (Fig. 7) strength was observed when stacks were used, even at high filler loadings. However, the tensile strength fell off with the addition of fillers (Fig. 8). The data on impact strength exhibited a high degree of scatter, and the indicated effect is that the use of kaolinite with a large fraction of stacks substantially improved the property (Fig. 9). It was also noted that the kaolinite fraction with a large amount of stacks appeared to give the best compromise in overall physical properties of the reinforced phenolic resin.

Conclusions

The physical properties of low, medium, and high unsaturated, reinforced polyesters were generally upgraded by addition of the proper type of kaolinite. In no cases were the physical properties significantly reduced by the addition of up to 40% of kaolinite. The medium unsaturated polyester had the largest increase in physical properties as a result of kaolinite addition.

Most of the physical properties of the two types of chlorinated polyesters tested were improved or unaffected by the addition of kaolinite. Tensile strength, however, was reduced, particularly at high loading levels for both resins. The use of the proper kaolinite fraction minimized the loss in this property.

The reinforced diallyl phthalate resin showed the greatest upgrading in physical properties by the addition of kaolinite of any

of the resins tested. Every property showed some improvement, and this was evident even at high filler loadings.

The physical properties of the reinforced epoxy resin were generally improved with the addition of kaolinite. Somewhat lower values were observed for impact strength, the only property lowered by filler addition. However, use of the proper kaolinite fraction minimized the reduction of this property.

Most of the physical properties of the reinforced phenolic resin were maintained with the addition of kaolinite filler at high loading. The tensile strength was the only property that could not be maintained by the proper selection of a kaolinite fraction.

Acknowledgment

The author wishes to acknowledge the assistance of the North American Fiberglass Corp., which fabricated and tested the samples in this investigation, and of W. R. Price and H. Raech, Jr., whose work made this report possible. Appreciation is also expressed to Dr. Hadyn Murray, J. H. Gans, and R. H. Bollinger, who reviewed this paper and gave helpful comments as well as to the Georgia Institute of Technology for the electromicrograph shown in Fig. 3.

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 41)*

Bakelite adding 55 million lb. of new capacity to low-pressure polyethylene industry

The announcement on page 43 concerning the new Bakelite high-density (low pressure) polyethylene plant at Institute, W. Va., emphasizes not only the ever-growing importance and volume of polyethylene plastics but also points up the Union Carbide position in polyethylene as the largest producer of high-pressure-processed material and also a major contender in the market for low-pressure-processed polyethylene. The new low-pressure-process plant at Institute, W. Va., now in operation and the Seadrift, Texas, plant which will come on stream soon will have a combined capacity of 55 million pounds.

Total capacity of all *high-pressure* polyethylene producers by the end of 1958 or mid-1959, including the new Carbide plant at Whiting, Ind., is expected to be close to 1.1. billion lb., of which Carbide or Bakelite will have around 350 million. That over one-billion-pound total of high-pressure polyethylene is somewhat dependent on what Dow and Monsanto may do since neither has announced its immediate plans.

An interesting note in this situation is that more than 300 million lb. of *high-pressure*-processed polyethylene capacity has been added or planned for in the past year and a half, including the new 72 million-lb. plant for Bakelite at Whiting which will have greater capacity than the combined output for the company's two new low-pressure plants. This 300 million-lb. addition is greater than the total amount of low-pressure polyethylene capacity now available.

The amount of low-pressure polyethylene capacity that has been announced as ready to produce is between 200 and 250 million lb.; involved are Phillips, Hercules, Celanese, Grace, Allied, Union Carbide, and Koppers' semi-works plant. The latter two will both have additional new plants in operation very soon. Their combined capacity will add another 55 million lb. or so to that above so that by mid-1959 there should be from 300 to 350 million lb. of low-pressure polyethylene capacity. This does not include what Dow and Monsanto may do. Goodrich has given no word of its intentions and the Kellogg license situation is quiescent. Du Pont has not yet started to build. Texas-Eastman and Spencer have not yet gone beyond the pilot-plant stage with their low-pressure material on license from Standard of Indiana.

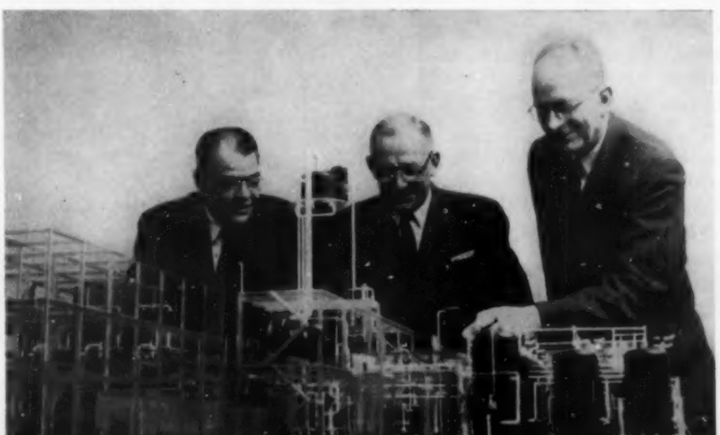
Thus, the total of all polyethylene capacity by mid-1959 should be over 1.4 billion lb., with more planned for the near future. Production of polyethylene in 1957 was close to 700 million lb. and sales were 650 million. It has been estimated that the amount of low-pressure material sold in 1957 was less than 10 million lb., but there are indications that it is now beginning to move at a much higher rate.

R. K. Turner, president of the Bakelite Co., Div. of Union Carbide, took particular pains to point out that the new high-density polyethylenes would create many new plastics markets because of their stiffness, low permeability, high service temperature, and freedom from distortion. However, he also stated that they would command a share of present plastics markets, including possibly 10 to 15% of the present market for low-density polyethylene. Housewares and wire and cable were items that he mentioned as particularly susceptible to the lure of high-density polyethylene because of rigidity, impact, gloss, abrasion resistance, and thin-wall construction.

Vinyl fluoride film: prospective material for laminates

A new plastic film with superior outdoor weathering characteristics is under development at Du Pont's Film Department. Carrying the experimental designation Type R film, the new material is being produced only on a laboratory scale and samples for experi-

John Beneditto, VP—sales, R. K. Turner, pres., and R. D. Glenn, VP —development of Bakelite Co., Div., Union Carbide Corp., look over model of Institute plant as development is turned over to sales



* Reg. U.S. Pat. Off.

News about R&A Adhesives

SINCE 1913

FOR ALL METALS AND ALL PLASTICS

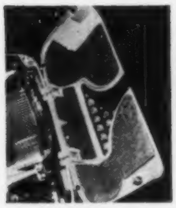
Two ways to bond rigid 'styrene foams without fear of cell attack

Working with "flexible" foams . . . ?

When it comes to "chemical fastening" flexible foams, the answers are not quite so clear-cut.

In 1947, R&A developed the first practical rapid tack-loss, one-part, fast-grab, soft-seam adhesive for foam rubber and our BONDMASTER R225 is still the leader in that industry.

And our most popular adhesive for vinyl foams (BONDMASTER C294) does an equally effective and economical job on that plastic...



Those "urethanes", though, are used so many different ways (to themselves, to metal, wood, fabric, grit, etc.) that the "best" formulation will depend not only upon the materials you are working with but upon the bond characteristics you consider most important.

We've over a dozen different formulations that are used to mass-production-bond urethane foams right now. One of these could very well be exactly what you are looking for.

Just detail your problem and we'll speed samples . . . without obligation of course.

RUBBER & ASBESTOS CORPORATION

243 BELLEVILLE AVENUE
BLOOMFIELD, NEW JERSEY

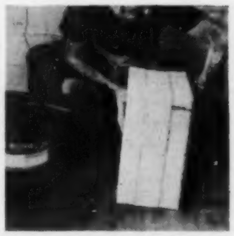
❶ ***Low-cost, fast-grab, high strength no-residual-odor, rubber-resin adhesives.***

❷ ***100% reactive, solvent-free epoxies.***

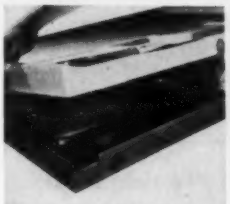
It doesn't take too much to collapse the cells of rigid polystyrene foams. You can do it with the pressure of your fingernail . . . or with the solvents used in most conventional adhesives.

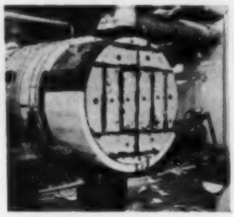
That's why even the solvents used in our BONDMASTER® G458 Series adhesives had to be specially formulated. And it's this "built-in" avoidance of cell attack that has made R&A's "chemical fasteners" for foamed polystyrene so widely specified.

The low-cost G458 Series is offered in several viscosities to permit efficient application by notched trowel, spreader, spatula, "push box", or spray gun.



New, high strength, low cost adhesives permit swift economical bonding of all rigid polystyrene foams to themselves, to metals, wood, masonry, other plastics . . . for high efficiency, lightweight insulation . . . for building construction, industrial equipment . . . without fear of cell collapse.





"CUSTOM-TAILORED" DRYING TIME

Most formulations in the series let you combine immediately. Others permit extensive time delay between applying the adhesive and assembling the components.

Either way, they enable you to overcome the key problems involved in bonding these plastic foams to themselves or to metals, wood, cement board, or other materials, since all feature high strength, moisture-resistance; resistance to odor absorption and transmission (essential in refrigerator work), resistance to freezing temperatures; and long-time aging properties in the completed bond.

WHY SOLVENT-FREE EPOXIES?

You wouldn't suppose heat resistance mattered since the foam won't stand too much, itself. However, there are some installations (mostly military) where a void-filling adhesive must resist "creep" at temperatures up to the foam's softening point . . . and under structural loads, at that! For such applications, most foam manufacturers' literature recommend a 100%-solids epoxy such as BONDMASTER M664 or M688.

For technical data and samples of the rubber-resins or the epoxies tell us about your specific problems.

The Plastiscope

mental use are consequently in extremely limited supply.

While further evaluation of manufacturing processes and potential markets will be required before a decision can be made whether to undertake commercial production, Type R film appears to have a promising future in many outdoor applications. Early laboratory samples have withstood 10 years' exposure to the elements in Florida without significant deterioration in physical properties.

Type R film is based on a new polymer, not now commercially available, of which the predominant monomer is vinyl fluoride. Polymers of this type are covered by U. S. Patent No. 2,419,010, and patent applications have been filed relating to processes for making the film.

The material is clear and colorless, with good transparency. It has high mechanical strength, excellent resistance to chemicals, transmits ultra-violet light, and retains its properties through a wide temperature range.

Significant properties are shown in the table below.

Type R film is heat-sealable by the impulse method, with seals approaching the strength of the film itself, and it may be metallized by vacuum deposition. It can be vacuum formed and embosses readily. In laminations with metals and other materials, it is postformable. While cost factors cannot yet be determined accurately, it is anticipated that Type R film, if manufactured on a commercial scale, would be in the general price range of Mylar polyester film.

Because of its ability to resist mechanical damage and prolonged weathering, Type R film appears to have promise as a surfacing material in laminations to metal, wood, and composition building boards and architectural panels. This application is of particular interest in the field of prefabricated buildings. Prefinished wall sections could be made in the manufacturer's plant, minimizing costly hand finishing operations on the building site. Cooperative evaluation programs in this field are being conducted at the present time with leading producers of aluminum, steel, wood, and composition board building materials.

Automobile manufacturers have expressed interest in weatherable films, including Type R film, metallized and laminated to metal or plastic, for exterior trim applications.

Type R film might be used for low-cost greenhouses which could be supported by light framing or low air pressure. Experimental greenhouses covered with the new film have been in service for periods up to three years in Florida and at the University of Kentucky, and are still in excellent condition.

Other uses being evaluated include air-supported structures of various types, storm windows, and plastic glazing for farm buildings.

Properties of vinyl fluoride film

Density	1.38
Sq. ft./lb., 1 mil	140
Tensile, p.s.i. $\times 10^{-3}$	14
Tensile modulus, p.s.i. $\times 10^{-3}$	300
Elongation, %	100
Tear strength, g./mil	25
Flex cycles, 1 mil	100,000
Moisture vapor transmission, g./100 m.^{2}/hr./mil	180
Oxygen transmission, g./100 m.^{2}/hr./mil	0.4
Use temperature, °F., Upper	250
Lower	—100
Chemical resistance	Excellent
Solar energy transmission, %	95
UV transparency	Yes

Plastics at the Toy Show

Summing up "Plastics' stake in toys" (MODERN PLASTICS 35, 88, Mar. 1958), this magazine stated that "it is already taken for granted in the industry that plastics are now used in more toys than all other types of materials." A survey of the March Toy Fair in New York bore out this statement.

One industry guess at the present value of plastics toys is $150 million wholesale, split up largely among polystyrene, polyvinyl chloride, polyethylene, and a small amount of cellulosics. Polystyrene was once the top plastic in the toy field, estimated at close to 42 million lb. in 1957, but polyethylene dominated the scene at this year's show. At the show larger and heavier polyethylene toys than ever before were on display—sturdy boats, fire trucks, etc. At the same time, the number of firms offering smaller polyethylene toys, such as 20- or 30-part soldier sets put up in polyethylene bags, has increased greatly.

These low-priced, large-volume toys, many of which are produced in simple, low-cost molds, are eating up enough resin to make any material manufacturer rub his hands with glee.

In the model kit field, a healthy specialty business for polystyrene material, the molding is getting more and more precise and intricate. Some of these kits, made in very costly molds, feature little figures less than 1 in. high with perfect detail in face, folds of clothing, etc.

The Jupiter C launching sent

many of these kit makers, as well as other toy manufacturers, scurrying to develop prototypes of missiles and satellites for display at the show. This "space" business, like all other highly detailed toys, will go largely to plastics.

Another growing market for polystyrene, particularly the impact variety, consists of toys made of vacuum formed sheet. One impressive example at the show was a large formed 2½- by 4-ft. combination wading pool-sand box. This product will widen an already well established market for vinyl inflatables.

Other items of particular interest at the show were large, blow-molded polyethylene bowling pins offered by two different companies. These products are blown on equipment similar to that used to make baby bottles.

Exports in 1957

Total exports of plastics materials in 1957 were generally higher than in 1956, according to a summation of the Foreign Trade Div. of the U. S. Census Bureau (see table below). The one exception in the major materials was vinyl chloride resin, which shows a lower export figure for 1957, doubtlessly the result of increased foreign production. The extreme growth in "resins not otherwise classified" is attributable to increased polyethylene exports. If the percentage of polyethylene in the 236 million lb. shown in the table for 1957 was the same as 1956, the total volume of polyethylene exported in 1957 was about 175 million pounds.

Vinyl chloride in Japan

Reports that vinyl chloride resin from Japan had been moving into the United States in ever-increasing quantities led an ambitious market researcher into a comprehensive study of the vinyl situation in that country and its possible effect on American markets. Here are some of his findings:

PVC output in Japan has grown from 2.2 million lb. in 1950 to 147 million in 1956. Sales of vinyl chloride resin in the United States have grown from about 300 million lb. to 630 million lb. in the same period.

Until 1957, sales in Japan were close to production, but in 1957 curtailed demand and increasing output resulted in sharply increased inventories with at least a 35 million-lb. inventory in September of that year. The price has dropped from 25.2¢ in June 1955 to 16.4 to 22¢ in October 1957, according to his report. Annual capacity rate has grown from about 50 million lb. in December 1954 to perhaps 400 million in early 1958.

Rigid pipe has been the largest consumer of vinyl for any product use in Japan. In May 1957, it went into that application at an annual rate of 75 million lb., but by August the rate had declined to 55 million. Producers of pipe reduced their price from 44¢ to about 25¢/lb.

It is estimated that 1957 shipments of all vinyl chloride totaled about 213 million lb., considerably above the 147 million lb. for 1956 but considerably below the capacity of over 400 million pounds.

Exports of all vinyl chloride resins from Japan were reported to be 4.6 million lb. in 1955 and 2.2 million lb. in 1956; but the annual rate in 1957 had grown from 2 million lb. in April to 18 million in August, although the total export for the year may not be much more than 4.5 million lb.; volume was extremely low until August. A PVC export association was formed in September 1957 for the purpose of promoting the sale of more vinyl abroad—the goal is 22 million pounds.

The rise in exports from Japan in August 1957 corresponds with the falling price of PVC resin. The originator of this survey thinks the situation will continue in 1958 until inventories of processed goods decline, especially in rigid pipe which now sells at about half the price of steel pipe. Note that this price situation is the reverse of that in the United States where steel pipe is much lower in cost than vinyl. The vinyl pipe now has 15% of the total pipe market in Japan, according to his report, and is expected to increase its share despite competition from polyethylene.

The summary of this report states that continued low prices for Japanese vinyl, averaging 18¢/lb., are a distinct possibility in 1958 and that it is doubtful that the price would rise over 22¢ even in 1959.

Other plastics in Japan

PVC for film bags are being used for packaging urea fertilizer in Japan, according to a note in Plastics Industry News, a trade paper devoted exclusively to Japanese plastics. Four fertilizer producers are using the vinyl bag. Plastics producers in the United

Export of plastics materials in 1956-57

Materials	*1956 in million lb.*	*1957 in million lb.*
Urea and melamine plastics	17.8	19.6
Cellulose acetate molding material	8.0	8.1
Cellulose acetate plastics for other uses	10.6	11.6
Vulcanized fibre	6.8	6.3
Styrene polymer and copolymer resins	57.9	63.1
Vinyl and vinyl copolymer resins, uncompounded	33.7	30.2
Vinyl and vinyl copolymer resins, compounded	13.7	15.1
Resins not otherwise classified	163.6	236.1
Laminated and molded not otherwise classified	4.9	5.0

The Plastiscope

States have long had their eye on that same market in this country, but up to now have not been able to meet lower cost competition.

Another item from the above source is a note on the decline of polystyrene imported into Japan. In the spring of 1957, it was about 1.2 million lb. a month; by October it had dropped to around 400,000. Total import of polystyrene into Japan from the United States in 1956 was 14.2 million pounds. Stated reason for the decrease was use of more domestic resin by the molders.

The Japanese plastics price list as published by the above magazine gives the following per-pound figures: butyral, $1.51½; cellulose acetate molding material, 56¾-62½¢; fluoride resin, $12.62⅝; melamine resin, $0.60⅝-62½; methacrylate, $1.03½; nylon molding material, $2.52½; general-purpose phenolic, 35⅜¢; DOP, 43-47⅞¢; polyethylene film grade, 48⅝¢; pipe grade, 50½¢; general-purpose polystyrene, 39⅛¢; general-purpose PVC, 20¼-23⅜¢; and urea resin, 27¾ cents.

Imports were reported for the first nine months as follows: phenolic resin, 650,000 lb.; polyester resin, 500,000 lb.; PVC, 1 million lb.; methacrylate, 800,000 lb.; polyethylene, 29 million lb.; polystyrene, 12.5 million lb.; and cellulose acetate, 132,000 pounds.

Argus enters European market

As a result of alliances with two overseas companies—Union Chimique Belge, Brussels, Belgium, manufacturer of industrial chemicals, and Lankro Chemicals, Ltd., Manchester, England—Argus Chemical Corp., Brooklyn, N. Y., will develop world markets for its patented line of vinyl stabilizers and plasticizers.

Argus has joined with the Belgian company in the formation of SA Argus Chemical NV to manufacture and sell Argus products in 11 European countries. Technical service and basic vinyl research will be continued abroad. William Leistner, founder and president of Argus Chemical Corp., was elected president of the new company. Technical personnel will be trained in the United States by Dr. Arthur Hecker, Argus' director of research.

Lankro Chemicals has been granted rights to represent Argus "Mark" stabilizers in all British markets, except Canada, and in the Scandinavian countries under the tradename "Lankro Mark."

U. S. model kits capture world market

The exhibit of Revell, Inc., Venice, Calif., at the recent New York Toy Fair provided an opportunity to inspect American hobby kits that will occupy children in 78 countries throughout the world, where the company's authentic all-plastic scale model kits are now being marketed.

Revell began exports to Europe in 1953, when the firm's domestic sales had reached $5.4 million. Early in 1955—with domestic sales at $7.8 million—the line of model kits was exhibited in Germany at the Nuremberg Toy Show. By June of that year, European manufacturers wanted molds and licenses and large orders from Germany started to come in.

In February 1956, Revell began manufacture of model kits in England, using molds which had already turned out $10 million in sales in the United States. In 1957, the English subsidiary, which according to B. G. Ramos, head of Revell's overseas operations, supplies about 40 countries, sold well over 1 million units.

A German subsidiary, the third manufacturing unit to use the original molds, started operation in June 1957. Another unit is operating in Mexico.

Revell, which has a line of more than 100 authentic scale model kits, ranging from a sports car which retails for 69¢ to the aircraft carrier "Forrestal" retailing at $2.98, adds about 35 new items to its line each year. Lewis H. Glaser, president and founder of Revell, points out that the American best sellers of the firm's models are also the most popular items abroad. Consequently, the company introduces new models simultaneously all over the world. Initially, foreign markets are supplied from the United States; after a year, the foreign subsidiaries begin marketing their own production, using the original molds. As soon as local production begins, the foreign subsidiaries can reduce prices by about 25 to 30% since duty and related expenses are eliminated.

Revell reached sales of $14.5 million in the U. S. in 1957, claimed to be about 50% of the total model market. In 1957, Revell, which uses polystyrene exclusively for its kits, consumed about 7,250,000 lb. of standard grades for its U. S. production. The foreign subsidiaries sometimes use high-impact formulations to meet the qualities of the domestically manufactured models because general-purpose polystyrene with the necessary properties is not always available to their purchasing agents.

Plastics Federation in India

As a result of the growth of the plastics industry in India, the Indian Plastics Federation, 4 Upper Chitput Rd., Calcutta 7, India, has been formed to represent the interests of all sections of the industry, including raw material producers, machinery manufacturers, importers, exporters, dealers, etc.

C. L. Gupta, of Peerless Plastics Industries Private, Ltd., Calcutta, was elected president.

Licenses for treating polyethylene

European licenses for treating of polyethylene for printing and gluing can now be obtained from W. H. Kreidl at Kreidl KG., 169 Engerthstr., Vienna 2, Austria, who has recently acquired European rights for Traver Investments, Inc. These treating processes include the Kreidl flame and heat process, as well as the Traver electronic process. Kreidl

is also licensing the film extrusion process which Traver Investments recently acquired.

This new process is said to increase output because it is not limited by the cooling rate as in blown film, and narrower widths can be produced at higher speed than wider widths, according to Traver, with the additional claim that there is less formation of pinholes and no interruption from blow-throughs as might occur in the blow method. Treatment for printing is an integral part of the process. The film is oriented in both directions and claimed to be stronger than blown film in both directions.

Mr. Kreidl also states that his firm has been granted sub-licensing rights by Bowe Paper Co. for Europe for that company's edge trim saving process for coating paper with polyethylene.

New preimpregnator

Latest entry into the field of resin-preimpregnated fabrics and papers for laminating and molding is Polyplastex United Inc., Union, N. J. The trade name for the material is Polyplastex B-Preg and involved are epoxy materials, polyesters, phenolics, silicones, melamine, and diallyl phthalate.

Complete data and instruction literature are available. Head of the company's technical service group is V. F. Settineri.

Vinyl plastisol stabilizers

Two amber, liquid vinyl plastisol stabilizers, Ferro 1701 and Ferro 1720, designed to give good early color retention and long-term heat and light stability, have been introduced by Ferro Chemical Corp., Bedford, Ohio. They are said to be non-sulfur staining, to possess good viscosity control and air release properties, and to have good compatibility.

Ferro 1701 has a specific gravity of 0.90 and less than A-2 Gardner viscosity. It is recommended by the company as a one-package stabilizer for pigmented or filled plastisols for use in molding, rotational casting, and dip or spread coating.

Ferro 1720, recommended as a heat stabilizer for casting, molding, and coating clear or pigmented and filled plastisols, has a specific gravity of 1.02 and A Gardner viscosity. According to Ferro, in many instances the stabilizer is efficient in the absence of epoxies.

Polyethylene paper coaters

At its recently held annual meeting, the Polyethylene Extrusion Coaters Group of Specialty Paper and Board Affiliates, Inc. elected Malcolm McVickar, Crocker, Burbank Papers, Inc., Fitchburg, Mass., chairman, and Martin L. Schechtman, Continental Can Co., Shellmar-Betner Div., Mt. Vernon, Ohio, vice chairman for the ensuing year.

Charles A. Southwick, Jr., technical editor of *Modern Packaging* Magazine and a packaging consultant, addressed the Group on the subject of "New Products and New Uses."

Judges for Bachner Award

Appointment of a panel of judges for the 1958 Bachner Award Committee has been announced. Arnold E. Pitcher, retired general manager of Du Pont's Plastics Div., will be chairman. Other judges named are: Hiram McCann, editor, MODERN PLASTICS Magazine; Charles E. Whitney, publisher, Whitney Publications, Inc.; Alfred Auerbach, Prof. of Marketing, School of Design, Pratt Institute; Dr. Ralph G. Owens, Dean of Engineering, Illinois Institute of Technology; and Henry M. Richardson, DeBell & Richardson, consulting engineers.

The award was recently established by Chicago Molded Products Corp. to stimulate and encourage the imaginative employment of plastics materials. Further information and application forms may be obtained from the secretary of the Bachner Award Committee, William T. Cruse, The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.

Parting films are sprayed on

Two new spray-on parting films, royal blue (V-264) and transparent (V-28), designed for use in polyester and epoxy molding operations, are now available from the Plastic Color Dept. of Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio. Consisting of polyvinyl alcohol in a water alcohol liquid medium, the film can be sprayed on the mold easily and quickly. When partially dry, the liquid forms a glossy film that separates the plastic part from the mold. After the formed part is cured and taken from the mold, the films are easily removed by stripping or washing with warm water.

The films are said to dry so quickly that little time is lost between application of the film and the molding operation. They can be provided in either a glossy or matte finish and can be formulated to adhere to sharp corners of the mold and to bridge-over slight mold defects. The films may also be treated to reduce air bubbles and blemishes.

The fact that V-264 is colored guides the sprayer in applying the proper thickness of film for each molding operation; since V-28 is transparent, it is unnecessary to strip or wash the film off the finished product.

Ferro liquid parting films have a shelf life in sealed containers of four to six months. They come ready to spray but can be thinned with tap water.

Widens polyethylene line

The addition of Fortiflex A-20 and Fortiflex A-250 to its series of rigid polyethylene resins has been announced by Celanese Corp. of America, 180 Madison Ave., New York 16, N. Y.

Fortiflex A-20 (melt index 0.2) is said to provide exceptional strength and resistance to stress cracking. It was developed particularly for blow molding of bottles and other containers and for extrusion of monofilaments and pipe.

Fortiflex A-250 (melt index 2.5)

is designed for intermediate injection molded products, which are said to combine easy flowability in molding, high surface gloss, and good impact strength. It is claimed to be suitable for such articles as housewares, toys, protective helmets, and industrial components.

Other members of the Fortiflex series are A-70 (melt index 0.7) and A-500 (melt index 5.0). The price for all types is 43¢/lb.

Color concentrates for vinyl

A new line of color concentrates in pellet form, claimed to give streak-free results in extrusion, is being offered by Blane Corp., Canton, Mass., manufacturer of vinyl insulation and vinyl color concentrates. According to the company, the concentrates blend better with the natural vinyl compound which is also in pellet form. They can also be used in dry blending operations.

New plastics plants in Puerto Rico

Perfumed flowers and drafting equipment are the most recent plastics products to be manufactured in Puerto Rico under the "Operation Bootstrap" program which has already encouraged the establishment of approximately 40 plastics factories in the Commonwealth.

Consolidated Plastics Co., San Juan, was formed to fabricate polyethylene and polyvinyl chloride into finished flowers by extrusion and injection molding. Fragrances supplied by Perfumers Legrand of Paris will simulate the scent of the natural flower. The company also plans to supply flowers without any fragrance for use by hospitals. The new 6000-sq. ft. plant is expected to produce 5000 plastics flowers a day.

Airmate Co., Toledo, Ohio, has formed an affiliate, Able, Inc., in Hormigueros, P. R., to manufacture T-squares, triangles, templates, lettering guides, and other drafting equipment from methacrylate. The Toledo company is investing $25,000 in equipment for the 11,500-sq. ft. structure and has hired an initial work force of 25 persons.

Epoxies

Foam-in-place compounds. Two low-density epoxy foam-in-place potting compounds—Sealfoam 601 and Sealfoam 603—which are expected to find wide application in the electronics industry, have been developed by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Sealfoam 601, with a density of 5 lb./cu. ft., is a two-component liquid which will expand and cure to a rigid, closed-cell structure reported to have good electrical characteristics and mechanical strength.

Sealfoam 603, with a density of 7 lb./cu. ft., is a single-component, free-flowing powdered material which requires a relatively low foaming temperature of 175° F. The cured material is claimed to have a compressive strength of 110 p.s.i., to maintain good electrical resistivity even at 350° F., and to be a good thermal insulator.

When used with an appropriate release film, Sealfoam 603 can readily be foamed into molded shapes. Without a film, it adheres well to most surfaces, assuring good support for foam-encapsulated resistors, capacitors, etc. The company reports that the resin expands from four to five times its loose powder volume.

Copper-clad laminate. A glass-epoxy laminate, used primarily in making its copper-clad laminates for printed circuits, has been developed by Taylor Fibre Co., Norristown, Pa. Designated Grade GEC-500, the laminate is furnished either plain or with copper cladding on one or both sides. According to the company, the circuit or copper design is easily pressed down to make it flush with the base laminate after the panel is etched. Sheets up to ⅛ in. thick, plain or copper-clad, can be punched; the material is easily machined. The base laminate is reported to meet the requirements of military specification MIL-P-18177A.

The base material is furnished in sheets approximately 37 by 49 in., in thicknesses from 0.010 to 1½ in., and in rods (ground from sheet stock) from ⅛ to 1½ in. in diameter. Copper-clad grades are furnished in sheets approximately 36 by 48 in., in thicknesses from 0.015 to 1 inch.

Impregnating and casting resins. Four types of impregnating resins (Isofil), primarily for use in the electronics field, and one casting resin (Isocast) have been introduced by Isochem Resins Corp., 221 Oak St., Providence 9, R. I.

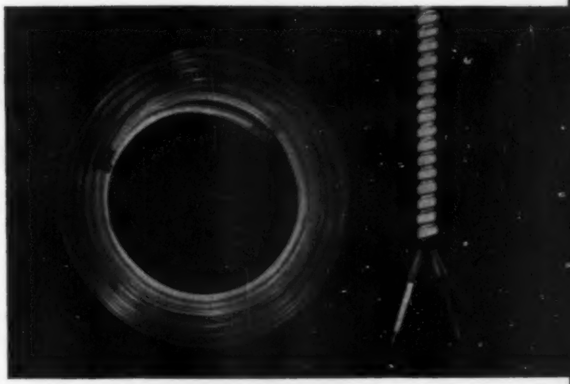
Isofil 201 and 202 are epoxidated polyester types characterized by high dielectric constants and low power factors. They are said to offer several advantages, such as chloride scavenging, low vapor pressure, low viscosity, and 100% reactivity. Isofil 221 and 222 are one-part modified, low-viscosity epoxy resins internally catalyzed to obviate mixing prior to use. They are claimed to possess indefinite pot life. According to the firm, the materials may be used as impregnants either at room temperature or may be warmed without danger of premature gelation.

Isocast 402 is a low-viscosity (6000 cp.) epoxy casting resin; the low viscosity is said to have been attained without the use of chain stopping reactive diluents or other modifiers.

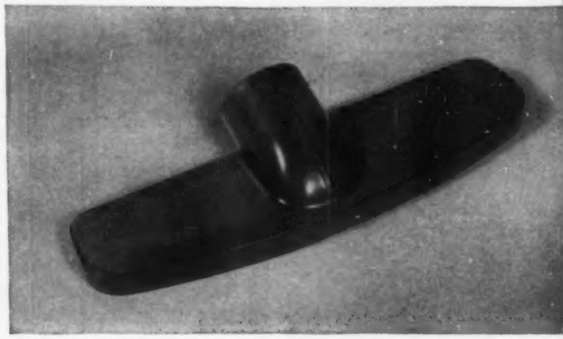
Colored epoxy pastes. Users of epoxy compounds or resins can now achieve a range of bright colors in the material by use of the Clinco epoxy dispersion series manufactured by The Clinton Co., 1210 Elston Ave., Chicago 22, Ill. The colored pastes are simply added to the coating, molding, casting, or insulating compounds.

There are seven standard colors, including black, and special shades can be manufactured if

When VINYL figures in your plans...specify OPALON



Monsanto has perfected more than 30 Opalon vinyl resins and compounds to meet the requirements of COMPOUNDERS OF VINYL PLASTISOLS for metal coating, slush-molding, foaming, dipping . . . MOLDERS of appliance parts, housings, toys, phonograph records, rain-wear . . . EXTRUDERS of wire and cable insulation, garden hose . . . CALENDERERS and EXTRUDERS of vinyl film and sheeting . . . MANUFACTURERS of vinyl floor tile . . . COATERS of textile and paper for upholstery and wall coverings. If Vinyl figures in your manufacture, draw on Monsanto experience, research, technical assistance, and productive capacity. Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.



Monsanto

OPALON: REG. U.S. PAT. OFF.

desired. Percentage of pigment in the paste varies from 15 to 58 (except for black which is 5), and price per pound in 5-gal. pails or 30-gal. drums varies from $0.95 for white to $3.40 for mercadium red. The vehicle portion of the paste is fine-quality epoxy and all colorants are claimed to have excellent resistance to color change due to the effects of light and heat.

Liquid resins. A water-white resin, based on bisphenol-A and epichlorohydrin, has been introduced by The Dow Chemical Co. Designated D.E.R. 332 (Dow epoxy resin), it is the monomeric ether of bisphenol-A rather than a conventional mixture of polymers. The resin is expected to be used for critical applications in laminating and electrical encapsulating where low viscosity and uniformity are required. According to Dow, the water-white clarity of 332 should open new fields for epoxies where the yellow or amber color of conventional resins could not be used.

Simultaneously, the company has put on the market two other liquid epoxies: D.E.R. 331, a standard unmodified resin suitable for customary use in tooling, casting, adhesives, and electrical encapsulating; and D.E.R. 334, a modified low-viscosity resin claimed to be especially suitable for laminating.

The resins will be produced at Dow's Freeport (Texas) Div., and prices will be in line with those presently prevailing in the industry.

Fire-resistant hardener. Comment in the industry indicates that Hooker's fire-resistant hardener for epoxies, introduced in 1957, is resulting in wide developmental and experimental activity.

Hooker Electrochemical Co. literature claims that its HET Anhydride is the only hardener to date that imparts fire resistance to epoxies. This characteristic is obtained by the large amount of chlorine built into the cured resin with the addition of HET Anhydride. Resins containing up to 30% stable chlorine can easily be obtained.

Handling properties of epoxies, such as pot life and strength, chemical resistance, high-temperature strength retention, and electrical properties of the cured resin are said to be directly dependent on the curing or hardening agent. The number of such agents is extremely varied. They are either primary and secondary amines or dicarboxylic acid anhydrides. HET Anhydride is one of the latter. The amines cure more rapidly, although it is reported that high temperature is necessary to develop maximum properties. Anhydrides have developed more slowly because they are solid and heat is required for mixing and curing.

However, according to Hooker literature, HET has certain advantages over amines, such as higher heat distortion temperature, fire resistance, better flexural properties of laminates at 350° F., no dermatitis or staining, and lower cost.

Resin in four blends. Maraset #639, a flexible casting resin which sets at room temperature, is the latest addition to the Maraset line of Marblette Corp., Long Island City, N. Y. It is offered in four blends with appropriate hardeners to provide the degree of rigidity or resiliency suitable for varying end uses.

Like Maraset #636, the new material is said to produce castings ranging from the flexibility of plastisol to the toughness of hard rubber, with the added convenience of polymerizing without heat. However, when more rapid setting is desired, the resin lends itself to a combination of room temperature cure and short oven cure.

The company's formulas 1 and 2 are said to attain hardness from 50 to 70 (Shore A test), tensile strength from 300 to 600 p.s.i., and an elongation rate from 45 to 60 percent. Formulas 3 and 4 yield castings of greater hardness, with tensile strength up to 2000 p.s.i. and elongation rates of 55 and 38%, respectively. Formulas 1 and 2 are used for gasketing and

mold-making applications; formulas 2, 3, and 4 are employed to face drop hammer dies for multiple stamping of metal panels. All four formulas are claimed to have high dielectric strength.

Maraset #639 is reported to be odorless, dimensionally stable, with good chemical resistance and good recovery characteristics. It adheres firmly to plastics, metals, ceramics, glass laminates, and other materials.

Anhydride curing agent. Methyl succinic anhydride, which is expected to find application as a curing agent for epoxy resins where clarity, light color, long pot life, ease of handling, and moderate heat distortion temperatures are required, is now available in research quantities from Chas. Pfizer & Co., Inc., 630 Flushing Ave., Brooklyn 6, N. Y.

Because of its low melting point (37° C.), the product may be mixed with epoxy resins at room temperature or with slight heating, and can be used with both aromatic and aliphatic epoxy resins. It is a saturated acid anhydride with a low molecular weight and, according to the company, will undergo hydrolysis, amidation, reduction, Friedel-Crafts reaction, Grignard reaction, and esterification.

Development price for research quantities is $3/lb.

High-heat potting compound. Helix Potting Compound P-460, a new 100% epoxy resin formulation offering extreme hardness and a temperature range from −80 to +450° F., has been announced by Carl H. Biggs Co., 2255 Barry Ave., Los Angeles 63, Calif. The compound is poured cold, cures in about 2 hr. at room temperature.

Raises heat distortion points. Tonox-P1, a curing agent for epoxy resins that raises heat distortion points and gives good electrical and chemical properties, is being produced by Naugatuck Chemical Div., United States Rubber Co. The hardener contains approximately 70% methylene dianiline; the balance is a mixture of polymeric materials which are also active curing

agents. It is a solid that can be converted to a liquid by heating to 80° C., and it will remain liquid for several days if held at temperatures between 35 and 40° C.

Hardener. An improved safety hardener, No. 50-A, has been announced by Kish-DeLorme Eastern Resin Sales, Inc., Teaneck, N. J., and Kish Industries, Inc. The hardener is reported to show good results in decreasing toxic effects without impairing the physical properties of the product.

Expansion

Midland-Ross Corp., Cleveland, Ohio, formed late in 1957 through the merger of The Midland Steel Products Co. and J. O. Ross Engineering Corp., has acquired **Hartig Engine & Machine Co.,** Mountainside, N. J., manufacturer of plastics extruding machinery.

Reported sales of Hartig for 1957 amounted to $3,113,000 and net profit was approximately $250,000. In the past five years, sales volume has increased from $1,284,000 and net profit from $105,000 to the record levels of 1957. Hartig's backlog of orders for the foreseeable future, according to **Wade N. Harris,** president of Midland-Ross, will continue to necessitate operation of the plant on a two-shift, six day a week basis.

Hartig's extruding machinery, built in the past three years, is capable of producing over 1 billion lb. of the over-all total of 4 billion lb. of finished plastics turned out in 1957, Mr. Harris asserted.

Edward Greene, president of Hartig and principal shareholder, will continue as the operating head of the newly-acquired company which will become a division of Midland-Ross.

Midland-Ross also announces that its **J. O. Ross Engineering Div.** has completed plans for the construction of a new Chicago office building in Mt. Prospect, Ill. The new structure will house

engineering and office personnel servicing the midwest areas. It will also house Chicago personnel of **John Waldron Corp.**, a unit of Ross Engineering which manufactures web converting machinery and flexible couplings. The new office will be headed by **L. G. Janett**, vice president and manager of the Chicago office.

Monsanto Chemicals (Australia), Ltd. has entered into an agreement with **Drug Houses of Australia**, Melbourne, to purchase all outstanding shares of two of that company's subsidiaries—**Beetle Elliott Pty., Ltd.** and **D. H. A. (Chemicals) Pty., Ltd.** Beetle manufactures phenolic, urea, and melamine molding powders, and polyvinyl acetate emulsions; D. H. A. (Chemicals) manufactures sulfuric acids and other chemicals. Both companies operate plants in the Sydney and Melbourne areas.

Principal shareholders of Monsanto Chemicals (Australia), Ltd. are **Monsanto Chemicals, Ltd. (England)** and **Monsanto Chemical Co.**, St. Louis, Mo.

Wasco Products, Inc., Cambridge, Mass., has purchased **Daylite Engineering Co.**, Van Nuys, Calif., manufacturer of combination skydome and power ventilation units. Daylite will operate as a division of Wasco and becomes the regional headquarters for distribution and sales of flashing and bath and shower enclosures, as well as all Wasco tradenamed products, including Skydomes, Pyrodomes, and Acrylite. Eventually the entire Skydome line will be produced at the Daylite Engineering Div. plant.

Manufacture of Daylite products will be continued, and the present staff and facilities remain unchanged.

Hawkridge Brothers Co., Boston, Mass., a metal warehousing firm, has purchased **Monsanto Chemical Co.'s Planishing Plate Division.** Planishing or polishing plates are used in the finishing of plastic sheets to an ultra-smooth finish.

These plates were formerly manufactured by Fiberloid Corp. which was acquired by Monsanto in 1938 and formed the nucleus of its present Plastics Division. A

The Plastiscope

segment of the production facilities of the Monsanto division will be moved to a new plant in or near the Boston area. As soon as this segment is in production, which is expected to be about July, the second line will be transferred to the new plant. Meanwhile, the two companies are building up a stockpile of plates.

Frank F. Jackson, retired superintendent of Monsanto's Plate Div., has joined the Hawkridge firm as consultant. **Asher E. Sylvester,** previously in charge of Hawkridge's plate sales, named division manager.

Solvay Process Div., Allied Chemical Corp., announces that it has more than doubled capacity of its vinyl chloride monomer plant at Moundsville, W. Va.

Narmco, Inc. has moved into its new $500,000 research and development center in San Diego, Calif., which will expedite development of reinforced plastics; high-temperature-resistance adhesives; high-strength metallic structures; and the design, development, and testing of aircraft and missile components.

The facility is equipped to carry out chemical, engineering, physical, and structural testing, and prototype fabrication.

Activities of the new laboratory will continue under the supervision of **Edward P. Carmichael,** director of research and development for the past 10 years.

Formica Corp., Div. of American Cyanamid Co., has installed a 4540-ton Baldwin steam-platen hydraulic press at its Evendale, Ohio, plant which will increase daily production by 25 percent. It is the third addition of almost identical units which have been installed at two-year intervals since the first was placed in service.

If the press runs a normal 24-hr. day, five and six days a week, it can produce about 12 million lb. of plastic sheets annually, according to the press

manufacturer. The press incorporates 14 openings in which a total of 112 sheets—8 per opening—can be cured at one time. In a normal 24-hr. day, the press can produce a total of 2240 sheets.

American Enka Corp., New York, N. Y., has acquired control of **Rex Corp.,** West Acton, Mass., producer of plastic-covered wire and cable. American Enka stated that the step was its first in a program of diversifying into industries outside the textile field.

The Dow Chemical Co. has licensed **C.S.R. Chemicals Pty., Ltd.,** of Australia, to produce high-impact polystyrene at a new plant at Rhodes, N.S.W., which was designed with the assistance of Dow engineers.

Duralastic Products Co., Detroit, Mich., has expanded its custom molding and engineering facilities with the purchase of a 64,000-sq. ft. structure at 5353 Concord at Frederick, Detroit. The building will house the firm's offices and manufacturing facilities. Duralastic produces fibrous glass and sisal reinforced parts for the automotive, furniture, and lamp industries.

Argus Chemical Corp., 633 Court St., Brooklyn, N. Y., has acquired a 3½-acre site across the street from its present building. The new plant will provide additional facilities for the production of Drapex plasticizers, Mark stabilizers, and fatty ketones.

Stoner Mudge Co., Div. of American-Marietta Co., announces the completion of a research and development center at Pittsburgh, Pa., which more than doubles its laboratory facilities and brings the total working area up to almost 14,000 sq. feet.

The company produces coatings for the plastics, paper, container, and other industries.

Ciba Co., Inc. is constructing an 80,000-sq. ft. building at Fair Lawn Industrial Park, Fair Lawn, N. J., which will house its executive, sales, and technical headquarters. The new structure will replace the present facilities at 627 Greenwich St., New York, N. Y.

Nicolet Industries, Inc. and its affiliate, **Modiglass Fibers, Inc.,** have moved into a new building at Florham Park, N. J., which will house the executive offices and research and development laboratories of both companies. Nicolet manufactures asbestos and Modiglass produces fibrous glass by a process developed by **Dr. Piero Modigliani,** executive director of research. The affiliate's manufacturing operations are conducted at Bremen, Ohio.

The new 20,000-sq. ft. structure includes chemical and physical testing laboratories, an engineering section, workshop, and a pilot area where new asbestos and fibrous glass products will be developed and new processing concepts evaluated.

Modiglass expects in the near future to enter the roofing material field and also to supply

fibrous glass material for anti-corrosion wrapping of various types of liquid and gas transmission lines.

Deceased

Paul L. Swisher, 59, vice president and a member of the board of **Reichhold Chemicals, Inc.**, White Plains, N. Y., died suddenly on March 9 of a heart attack. He had been affiliated with the company for 24 years.

Carl F. Lindholm, 66, president of **Independent Die & Supply Co.**, St. Louis, Mo., and **New Era Die Co.**, Red Lion, Pa., died on March 7 following a long illness.

Meetings

May 14-16: The University of Wisconsin, University Extension Division, Plastics Molding Institute, Madison, Wis. For personnel interested in molding techniques. Robert L. Loetscher in charge.

May 20-21: The Chemical Market Research Association, Annual Business Meeting and Open Technical Session, Hotel Statler, New York, N. Y.

May 28-29: Deutsche Gesellschaft für Chemisches Apparatewesen (DECHEMA), 2nd Congress of the European Federation of Chemical Engineering, Brussels, Belgium. (To be continued at Frankfurt am Main, Germany, May 31-June 8.)

May 31-June 8: DECHEMA, European Congress of Chemical Engineering and ACHEMA 1958 Congress, 12th Exhibition and Congress of Chemical Engineering, Frankfurt am Main, Germany.

June 12-14: Manufacturing Chemists' Association, 86th Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va.

June 18-28: British Chemical Plant Manufacturers Association and the Council of British Manufacturers of Petroleum Equipment, 1st Chemical and Petroleum Engineering Exhibition, Olympia, London, England.

July 7-11: National Housewares Manufacturers Association, 29th National Housewares Exhibit, Atlantic City Auditorium, Atlantic City, N. J.

Companies . . . People

Allied Chemical & Dye Corp. has changed its name to **Allied Chemical Corp.** since dyes are no longer the predominant material produced by the company. Allied's six operating divisions have about 30,000 employees who produce some 3000 products at more than 120 locations. Among the company's plastics and related products are: polyethylene, isocyanates, caprolactam for nylon fiber and molding material, plasticizers, phthalic anhydride, melamine, urea, alkyd, and phenolic resins.

Allied also operates 12 laboratories which employ more than 1600 chemists and technicians. The company's research expenditures have grown from $8 million a decade ago to $17.5 million. In the same period, Allied's sales have risen from $387 million to $683 million.

Monsanto Chemical Co.—Plastics Div., Springfield, Mass.: **Theodore S. Lawton**, formerly an asst. dir. of sales, will head the newly consolidated Market Development Dept. as dir. He will coordinate advertising and sales promotion, automotive sales development, creative design, industrial and building applications, and market research. **Ralph F. Hansen**, previously mgr. of market development, now asst. dir. of market development. **Luigi A. Contini**, formerly asst. mgr. of market development, becomes mgr. of creative design. **Margaret L. Reid**, appointed mgr. of market research. **Thomas A. DeMarco** will continue as mgr. of industrial applications in addition to assuming new responsibility for building applications. **Edmund D. Kennedy** remains mgr. of advertising and sales promotion. **Joshua S. Miller** continues as mgr. of automotive sales development.

Union Carbide Chemicals Co., Div. of Union Carbide Corp.: Robert L. Duncan, named sales mgr., will direct the field sales force. **De France Clarke** appointed mgr. of the recently established New Projects Dept.

Three promotions in the Development Dept. at South Charleston, W. Va.: **A. C. Hamstead** and **H. M. Rife**, staff associates and **L. S. VanDelinder**, group leader. Messrs. Hamstead and Rife will serve as consultants and advisors in construction materials and vinyl polymers, respectively.

Du Pont—Polychemicals Dept.: Dr. William H. Calkins named mgr. of a newly created section on acrylics research; **Dr. Dwight H. Johnson** appointed mgr. of the application research section. Both appointees were formerly sr. supvs. in the Research Div. at the Experimental Station.

General Electric Co.—Chemical and Metallurgical Div., Pittsfield, Mass.: **Frank P. Florentine** named mgr. of the phenolics engineering unit of the Chemical Materials Dept.

Laminated Products Dept. The Textolite laminated products sales offices in Boston and Atlanta have moved to new locations. The Boston office has been relocated from 140 Federal St. to 145 N. Beacon St., Boston 35 (Brighton), Mass.; and the Atlanta office from 795 Peachtree St. Bldg., to 3131 Piedmont Ave., N.E., Atlanta, Ga.

Sommers Plastic Products Co., New York, N. Y.: The following officers elected: **Herman J. Schecter, pres.; Matty Matlin**, exec. VP; **Irving Rifkin**, VP—sales; **Saul Altman**, treas.; and **Jack Schecter**, secy. The firm is a distributor for the **Plastics Div.** of **The General Tire & Rubber Co.**

These officers were also named to similar posts at **Sommers Fabrics**

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Welding Engineers, Inc., Norristown, Pa.: **John B. Hendrickson**, pres. since 1925, elected to newly created office of chrmn. of the board. **William H. Hendrickson, Jr.**, exec. VP, succeeds him as pres. **John G. Hendrickson** elected VP and **Charles R. Hires**, VP—manufacturing. **Louis F. Street** named mgr. of marketing.

The company manufactures compounder-extractor-extruders and allied equipment for the plastics and rubber industries.

Exclusive sales rep. for Continental Europe and the British Isles is **Welding Engineers, Ltd.**, 1-3 Chantepoulet, Geneva, Switzerland. **Pat Sauter**, formerly sales mgr. of Hydro-Chemie, Ltd., will assume a similar post with the Geneva firm.

Commercial Chemical Development Association: Following officers elected for the period from July 1958 to July 1959: Pres.—**L. E. Johnson**, supv. of Industrial Chemicals Section, Development and Research Div., **International Nickel Co.**; pres.-elect—**Walter J. Riley**, mgr. of Market Development Div., **Westvaco Mineral Products Div., Food Machinery & Chemical Corp.**; treas.—**A. J. Dirksen**, eastern gen. sales mgr. of **American Potash & Chemicals Corp.**; and exec. secy.—**J. G. Affleck**, mgr. of Rubber Chemicals Dept., Organic Chemicals Div., **American Cyanamid Co.**

Bernard H. Jacobson, VP and dir. of **Food Machinery & Chemical Corp.**, was awarded the 1958 Honor Award of the Association in recognition of his outstanding role in the commercial development of plasticizers.

National Cylinder Gas Co.—Girdler Process Equipment Div., Louisville, Ky.: **Bruce D. Miller** appointed VP—manufacturing, **Allen M. Bond, Jr.**, dir.—engineering and product development, and **N. T. Joyner**, gen. sales manager. The following sales mgrs. named: **Boyd R. Hopkins**—Thermex; **Lamar D. Roy**—Votator; **H. E. Huber**—process plants; and **E. T. Beck**—overseas operations.

The company manufactures Votator continuous processing equipment, high-speed Votator container fillers, Thermex high-frequency dielectric heating equipment, and other electronic and mechanical processing devices for the plastics, chemical, petroleum, and other industries.

Holland Color & Chemical Co., Holland, Mich.: Four manufacturer's reps. appointed: **Herbert B. Lewis**

Companies . . . People

Co., 30 Huntington Ave., Boston, Mass.; **George C. Brandt, Inc.,** 1925 Market St., Denver, Colo.; **Robert F. Sheahan Co.,** 198 S. Main St., Memphis, Tenn.; and **Drew Brown, Ltd.,** with offices in Toronto, Ont., Montreal, Que., and Vancouver, B. C.

Wilson & Geo. Meyer & Co.: William R. Kidder elected a VP of the firm and named sales mgr. of the **Southwest Plastics Div.,** with headquarters in Los Angeles, Calif. **Dr. D. W. Carley** appointed sales mgr. of the Southwest division. **Alfred S. King** made sales mgr., with headquarters in San Francisco. The firm is Pacific Coast distributor of chemical products and synthetic fibers made by **Eastman Chemical Products, Inc.**

Waljohn Plastics, Inc.: Robert L. Bouse appointed gen. mgr.—sales for the parent company and its subsidiaries, **The Rotuba Extruders, Inc.** and **Maridon Mfg. Co.,** all located at 437 88th St., Brooklyn 9, N. Y. **David Friedwald** joined the sales force and will cover the metropolitan New York area.

O'Connell & Associates, 2514 W. Peterson Ave., Chicago, Ill., named Chicago sales rep. and **Jannel Plastic Sales,** 5620 Broadway, Cleveland, Ohio, Cleveland sales rep.

Formica Corp., Div. of American Cyanamid Co.: Richard E. Noble appointed to newly created post of asst. mgr.—manufacturing. He will be in charge of production, plant engineering, and industrial engineering at the firm's Evendale and Winton Place, Ohio, plants.

A branch office has been established in the J. M. S. Bldg., South Bend, Ind. **L. E. Dugan** will head the office.

Midwest Plywood Co., 10123 Lyndon Ave., Detroit, Mich., plywood wholesaler, has formed a **Plastics Laminate Div.** to distribute **Pioneer Plastics Corp.'s** Pionite high-pressure laminates in the Michigan-Ohio area. **William Champion** named special and tech. rep. for the new division.

Commercial Plastics & Supply Corp., 630 Broadway, New York 12, N. Y., appointed authorized distributor for Plexiglas acrylic sheets manufactured by **Rohm & Haas Co.** and for polyethylene film produced by **Visking Corp.**

The company is stocking all colors, sizes, thicknesses, and grades of Plexiglas sheets in its New York plant and at branch sales offices and warehouses. Commercial will also promote the use of Visking's polyethylene film in such applications as

Companies . . . People

outdoor construction, industrial tarpaulins, and as weather and moisture barriers. It will carry stocks in all its storage locations.

Imperial Chemical & Plastics Corp., 16 W. 40th St., New York, N. Y., has established an Art and Styling Dept. to assist customers with coloring, styling, and design problems involving the use of vinyl film and sheeting. **Mrs. Mal O'Reilly**, stylist, will head the department.

National Starch Products, Inc. has moved from 270 Madison Ave. to enlarged quarters at 750 Third Ave., New York 17, N. Y.

Lawrence J. Horan named mgr. of the **Southeastern Div.** in Atlanta, Ga.

The Industrial Rubber & Plastics Co., 550 E. 99th St., Cleveland 8, Ohio, is the new name of the company formerly known as The Industrial Rubber Bonding & Tire Co. The firm specializes in the application of plastics and latex coatings to metals and in tire retreading.

Knickerbocker Plastic Co., N. Hollywood, Calif., has received an Honorable Mention Award in the toy field in the 1958 Versatility Contest sponsored by **Hess Brothers**, Allentown, Pa. The award was presented to Knickerbocker for its polyethylene Prairie Sand Schooner. When taken apart, the top of the schooner becomes a sifter, the bottom portion of the yoke becomes a shovel, and the wagon itself can be used as a sand carrier.

L-O-F Glass Fibers Co.—Corrulux Div.: Richard C. Schofield, formerly West Coast regional mgr., now midwest regional mgr., distributor sales; **L. V. Warner** named midwest regional mgr., industrial sales. They will headquarter at 230 N. Michigan Ave., Chicago, Ill.

Enjay Co., Inc., New York, N. Y., marketer of petro-chemicals, has opened a new sales office at 207 Hawthorne Lane, Charlotte, N. C. **J. W. Toney** will head the office and **D. L. Duncan** will serve as tech. rep.

Resolite Corp., manufacturer of structural plastic panels, has opened a southeastern regional sales office at 204 14th St., N.W., Atlanta, Ga., with **G. D. Griffin** as regional sales mgr.

Alden & Ott Printing Inks Co. has established a plant and offices at 4030 N. Rockwell St., Chicago 18, Ill. The company manufactures letterpress, lithographic, and silkscreen inks for printing polyethyl-

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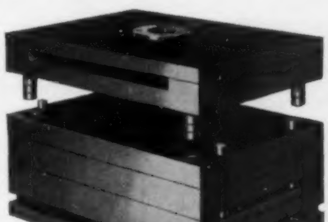

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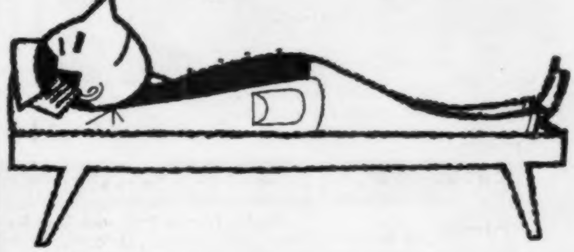

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ene, vinyl, styrene, and other plastics in molded, film, and sheet form. **Joseph G. Alden** is pres. and **Henry J. Ott** is VP.

Fife Mfg. Co., Inc., manufacturer of automatic web guiding equipment, has moved from 4th St. and N. Western to its new plant at 201 N.E. 48th St., Oklahoma City, Okla.

Wilson Plastic Container Corp., burned out of 55 N. 4th St., is now located at 25 N. 3rd St., Brooklyn 11, N. Y.

E. V. Roberts & Associates, 5068 W. Washington Blvd., Los Angeles 16, Calif., engineering sales reps., appointed to represent **Flightex Glass Fabrics** in the southwest. Flightex has a mill and finishing plant in Clifton, N. J., and offices in New York City.

L. F. Doyle, previously with Furane Plastics, Inc., named sales engineer of **Roberts' Chemical Materials Div.**

Martin C. Hutt Sales Co., 146 Front St., Berea, Ohio, named Cleveland sales rep. by **Reichhold Chemicals, Inc.** for polyester, epoxy, and melamine resins.

Howard O'Leary & Associates, 18550 Mack Ave., Detroit, Mich., named Michigan sales rep. by **Nosco Plastics, Inc.**, Erie, Pa., custom injection molder.

Canada Fabrics, Ltd., Toronto, Ont. named distributor to the textile industry in Canada for urethane foam manufactured by **Scott Paper Co.,** Chester, Pa.

Steiner Paper Corp., 601 W. 26th St., New York, N. Y., appointed national distributor of Celanese Prepared Acetate, a transparent coated plastic sheet used in the graphic arts.

Dr. George E. Ham, formerly research dir. of J. T. Baker Chemical Co., appointed tech. dir. of **Spencer Chemical Co.'s Plastics Div.,** Kansas City, Mo.

Robert M. Gray, with the company 24 years and formerly advertising mgr., appointed mgr. of the **Advertising-Sales Promotion Div.** of **Esso Standard Oil Co.,** 15 W. 51st St., New York 19, N. Y.

Dr. Alex Lewis, Jr., previously in charge of chemical marketing for the Petrochemicals Dept. of **Gulf Oil Corp.,** Pittsburgh, Pa., promoted to mgr. of the department to succeed **L. O. Crockett** who was recently elected pres. of **Goodrich-Gulf Chemicals, Inc.,** Cleveland, Ohio. Dr.

Companies . . . People

Lewis will be concerned with direction of Gulf's petrochemical interests, including ethylene, propylene, benzene, toluene, iso-octyl alcohol, sulfur, and gasoline additives.

Richard A. Smith, Jr. elected VP of **Jones-Dabney Co.**, a Div. of **Devoe & Raynolds Co., Inc.**, Louisville, Ky., succeeding **J. C. Wilcox** who has retired. Mr. Smith was formerly industrial sales mgr. of the Louisville plant.

Lawrence D. Bragg, Jr., formerly gen. mgr. of Respro Div., The General Tire & Rubber Co., now dir. of development, **Plastics Div., Plymouth Rubber Co., Inc.**, Canton, Mass. The firm manufactures vinyl upholstery materials.

William M. Keller appointed VP and gen. mgr. of the newly formed **Fiberglas Reinforced Plastics Div.** of **Owens-Corning Fiberglas Corp.**, 598 Madison Ave., New York, N. Y.

Keith R. Cranker, formerly with Thiokol Chemical Corp., appointed dir. of research and development of **Plumb Chemical Corp.**, Philadelphia, Pa., manufacturer of Fibercore molding compounds.

Charles M. Scholz, gen. sales mgr. of **The Landers Corp.**, Toledo, Ohio, elected VP—marketing. The company manufactures coated fabrics for automotive and upholstery uses.

J. G. Somers, gen. mgr. of **Consoweld Corp.**, Wisconsin Rapids, Wis., elected chrmn. of the Decorative Laminate Group, Laminated Products Section, **National Electrical Manufacturers' Association.**

Dr. John C. Lawler appointed special projects coordinator of the **Dyestuff and Chemical Div.** of **General Aniline & Film Corp.**, 230 Park Ave., New York 17, N. Y. He will be on the staff of **Dr. C. C. Schulze**, mgr. of manufacturing for the division.

J. E. Callahan now mgr. of **Air Cruisers Div., The Garrett Co.**, Belmar, N. J. The division develops and manufactures inflatable survival equipment and Pacton plastics, including non-metallic armor, radiation shielding, polyesters, and silicones.

James L. Harvey, formerly pres. of Plumb Chemical Corp., now mgr. of reinforced plastics development, **Industrial Products Div., The General Tire & Rubber Co.**, Marion, Ind.

Robert L. Merrick named chief project engineer of the **Chemical Plants Div.** of **Blaw-Knox Co.**, Pittsburgh,

Pa. The division provides engineering and construction services to the chemical, petroleum, and allied industries.

Robert E. Leber appointed gen. sales mgr. of **Ansbacher-Siegle Corp., Div. of Sun Chemical Corp.,** Rosebank, Staten Island, N. Y. He will be responsible for sales of all A-S products, including organic pigments, dispersions, and flush colors.

Robert F. Hill, previously asst. sales mgr. of the Vinyl Resin Dept. of Monsanto Chemical Co., named sales mgr. in charge of the Resin Sales Dept. of **Eleonora Chemical Div., The Pantasote Co.**

Kenneth M. Hayes appointed to the newly created post of mgr.—sales promotion and training of **Taylor Fibre Co.,** Norristown, Pa., manufacturer of vulcanized fiber and laminated plastics.

H. Dorn Stewart, formerly marketing mgr. of Armstrong Cork Co.'s Floor Div., has been appointed asst. to **Carlton Bates,** exec. VP of **Allied Chemical Corp.,** 61 Broadway, New York, N. Y.

Donald R. Meserve, product mgr. of organic coatings at **Metal & Thermit Corp.,** recently elected chrmn. of the **Vinyl Dispersion Div.** of **The Society of the Plastics Industry, Inc.**

Richard J. Savage appointed marketing mgr. for polyester resins for **Archer-Daniels-Midland Co.,** Minneapolis, Minn.

Al Schwider named mgr. of the **Structural Div.** of **Hastings Plastics, Inc.,** 1551 12th St., Santa Monica, Calif.

Carl H. Bagen, previously mgr. of tech. sales, now sales mgr. of **Kaye-Tex Mfg. Corp.,** 110 E. 23rd, New York, N. Y., manufacturer of vinyl film and sheeting.

Capt. Floyd B. T. Myhre named asst. to the pres. of **Witco Chemical Co.,** New York, N. Y. Capt. Myhre will head the company's Washington office at 734 15th St., N.W., Washington 5, D. C.

John I. Masters appointed Western Div. sales mgr. of **Park Nameplate Co., Inc.** Flushing, N. Y., manufacturer of anodized aluminum foil for identification and decorative purposes, with headquarters at 140 N. Robertson Blvd., Beverly Hills, Calif.

Correction

"Transformer transformed by premix," (MODERN PLASTICS 35, 97 April 1958): Photo credit for old-type transformer was incorrectly given. Correct credit should have been Westinghouse Electric Co.

Classified Advertisements

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and equipment for sale

FOR SALE: 8—125 ton, 1—75 ton hydraulic compression molding presses. Individual power units, pull back cylinders, knockouts. Priced for quick sale. Triboro Electric Corp., 110 Waterbury St., Brooklyn 6, N. Y., HY: 7-3535.

FOR SALE: Akron Preform 6 spindle rotational casting machine. Also 14 spiders of 2, 3, 4, 5 and 6" bouncing ball molds. Reasonable. For complete details, Reply Box 3520, Modern Plastics.

FOR SALE: 450, 350, 100 and 30 ton self-contained compression molding presses; 3 Cumberland 0, ½ granulators, 3 HP; 3 Stokes preform presses, R, T and RD-4; 1 22 x 60" plastics mill, 150 HP; 1 Baker-Perkins 200 gallon jacketed mixer; also grinders, extruders, presses, etc. Chemical & Process Machinery Corp., 52 Ninth St., Bklyn 15, N. Y.; Phone: HY 9-7200.

FOR SALE: 10H-24 oz. Reed-Prentice reconditioned automatic hydraulic plastic injection molding machine, complete with drive motor and controls. Write for details to Nosco Plastics, Inc., Erie, Pa.

FOR SALE: Injection Presses: Automatics in Stokes 4 oz., and Watson 5 oz. —Jackson Church 64 oz., HPM 24 to 4 oz. sizes.—Reed 24, 16, 12, 8 & 4 oz. Lester 8 oz. Watson 48, 28 oz. De Mattia 4 oz. vertical. Lewis 6 oz. Moslo 2½ oz. Van Dorn 1 oz.—for extruders: 30" Sheet Die w. 52" Pull-Off. 36" Brown Vac Form & Plug-assist setup. Dulmage 28" Meter-pump. Royle 3½" oil htd. extruder. Despatch PLHD 2-5 lo draw. Oven. Cumberland model 0 & 10 grinders. Mold chiller circul.—2 HP Boilers.—Apex 2 col. container imprint mach. Markem 25 A printer.—Compression presses various sizes.—Elmes Hydrolair 30 T. presses. —Preformpresses Stokes 280 G & Defiance 45.—Baker-Perkins 200 gal. mixer. 42 cft. ribbonmixer. Vac. forming machines 30 x 30"—Dake 200 T. Hydr. press. List your surplus equipment with me.— WANTED: Extruders 1½ to 6". Defiance 20 preformpress.—All Midwest locations. Justin Zenner, 823 Waveland Ave. Chicago 13, Ill.

FOR SALE: Injection molding machines, 3 oz. Fellows, 8 and 12 oz. Lesters, 50 oz. Impco—400 ton 36" x 36" and 1000 ton vertical presses—No. 1½ Ball & Jewell rotary cutter—Carver laboratory presses and others to 75 ton—6" x 13" laboratory mills—miscellaneous hydraulic valves and fittings. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N. J.—cable address Plasmex-Boonton.

FOR SALE: Vacuum forming machine 23" by 21". Automatic cycles, factory demonstrator, guaranteed. Will consider trading for good injection molding machine. Atlas Vacuum Corporation, 340 Lyell Avenue, Rochester 6, N. Y.

FOR SALE: 1 Gorton model Pl-2 Pantograph with 5/16" capacity, removable Panto-Collet Spindle, including 5/16" Collet, less copy holder. Arranged for 110 volt, single phase, 60 cycle—type also available. P.O. Box 5066, Knoxville, Tennessee.

MACHINERY FOR SALE: National machine company, 2" saran extruder, X-Alloy liner, nickel screw, steam jacketed. 10 H.P. U. S. Varidrive. Two years old. Used 750 hours. Submit offers to Michigan Pipe Company, Box 87, Gagetown, Michigan.

FOR SALE: 6—Pfaudler 500 gal. glass-lined reactors. 7—stainless reactors: 50, 100, 150, 200, 450, 465 gal. 1500 HP Farrel horiz. reducer. Sigma blade mixers—2¼, 5, 10, 20, 30, 60, 75, 100, 150 gal., stainless and steel. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

BALL & JEWELL GRINDERS: 1—No. 1½: 30-HP Motor, 220 3-phase, ball bearing, stand, magnetic switches, extra knives sets, screens, etc. 1—No. ½-D.T. V-belt drive. Inspection at our plant invited. No Reasonable Offer Refused. Reply Box 3523, Modern Plastics.

FOR SALE: (6) 100 ton, 10" ram, 10" stroke @ $1250; (7) 200 ton, 9" stroke, 14" ram, 36x36, @ $2160; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) ton complete, 18x18 @ $1850; (1) 200 ton 16" ram, 30x30 @ $2460; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 386-90 Warren Street, Bklyn, N.Y.

FOR SALE: 64 Oz. Injection Molder with Pre-Plasticizer mold size 32"x50" 750 Ton clamp. Lester 8 oz. Model 2 ½L (1949). DeMattia 12 oz. (1946). DeMattia 4 oz. H.P.M. Rubber Injection molders, 21½" x28" mold space, steam heated platens. Watson-Stillman 300 Ton Semi-Automatic Compression molding Press (1947) self-contained, mold size 34"x27". Watson-Stillman 250 Ton 28"x24". Watson-Stillman 140 Ton 22"x16". Waterbury Farrel 85 Ton 20"x24". W.F. 63 Ton 15"x15". Laboratory Presses—15 Ton 10"x8" and 10 Ton 6"x6" Platens. Scrap Cutters, Valves, Accumulators, Hydraulic Presses —all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

FOR SALE: 2 Denison presses, 25 and 15 ton; 1 Baker Perkins 15USE, 100 gal. all stainless double arm Vacuum mixer; 1—Baker Perkins size 15VUUM, 100 gal. double arm mixer, 100 HP motor; 1—Baker Perkins size JNM 100 gal. double arm mixer; 6—Day 250 and 100 gal. double arm mixers; 1—Ball & Jewell #1 Rotary Cutter; 2—Two Roll Mills 6" x 12"; 6—Stokes model DD2, DS3, D3 and B2 Rotary Preform presses; 4—Stokes model "R" single punch Preform presses; Also: Sifters, Banbury mixers, Powder mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

GOOD EQUIPMENT: At the right price. Falcon Ribbon Blenders in Steel or Stainless; NRM 2½" Extruder, Rotary Cutters by Ball & Jewell, Sprout-Waldron, Abbe; Baker Perkins heavy duty dbl. arm Mixers, 100, 200, 300 gal; French Oil Mill Hydr. Press 450 Ton; Blaw Knox S/S Resin Kettle 7'6"x7'6", Jktd. Agtd.; Sturtevant 300 cu. ft. Batch Mixer; Stokes and Colton Rotary and Single Pre-form Presses; Send for new First Facts, containing complete illustrated inventory; First Machinery Corp., 209 Tenth St., Bklyn 15, N.Y. Fred R. Firstenberg, Pres.

FOR SALE: Two 1953 model 16 oz. Watson-Stillman 400 ton plus injection machines. 47½ horse power. Fast cycle. Now running. First-class condition. Available on or after June 1st. Price, photographs, spare parts list available on request. Reply box 3511, Modern Plastics.

FOR SALE: 2 oz. Van Dorn, lever type, $1650; (3) 2 oz. aut. molding machines w/accumulator; 4 oz. Lewis, 1954, $3500; 4 oz. Acme, 1953, $5000; 4/6 oz. R-P, 1955; 4 oz. vert. DeMattia; 8 oz. R-P, 1948, $6500; 8 oz. R-P, 1946, $6000; 12 oz. W-S Model E, $6500; 12 oz. DeMattia, toggle, $5000; 12/16 oz. DeMattia, Model M, $16,500; 12 oz. Lester w/solid frame, $5500; 16 oz. & 20 oz. vert. Impcos; 20 oz. R-P w/32 oz. cyl., almost new; 32 oz. R-P w/48 oz. cyl. exceptional; 48 oz. W-S, 1950; Model #246 Vactrim vacuum former; Preplasticizer for 16 oz. H.P.M., 48 oz. cap., almost new, for Model 350 B; tumbling barrels, ovens, grinders, etc. Partial listing—other equipment available. Acme Machinery & Mfg. Co., Inc., 2315 Broadway, New York City, SU 7-1705.

LIQUIDATION SALE: Molding Plant; (2)—375 Ton French Oil Compression Presses. (1)—300 Ton Erie Compression Press. (2)—170 Ton Transfer Presses. (1)—100 Ton Compression Press. (3)—75 Ton Transfer Presses. (1)—No. 5½ T Colton Preform Machine. (1)—3 DT Colton Tablet Machine. Compressors, Pre-Heaters and miscellaneous shop equipment. Reply Box 3519, Modern Plastics.

FOR SALE: Stokes 300 ton and Baldwin-Southwark 200 ton semi-automatic Transfer Molding presses. Thermal (La Rose) Preheaters. 2500 ton downstroke 54"x102". 300 ton multi-opening 40"x40". French Oil 250 ton 38"x28". Elmes 200 ton 28"x26". Farrel 200 ton 20"x80". 200 ton Hobbing Press. 200 ton 16" Record Presses. D&B 140 ton 36"x36". French Oil 120 ton self-contained. W.S. 120 ton 24"x24". Also Lab. Presses to 100 tons. Hydraulic Pumps and Accumulators. Van Dorn 1 and 2 ounce Injection Machines. Other sizes to 80 oz. Baker-Perkins and Day jacketed Mixers. Plastic Cutters. Oxford 57" Slitter. Seco 6"x13" and 8"x16" Mills and Calenders. Oil and Elect. Plastic Extruders, lab to 6". Single & Rotary Preform Presses ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Co., 107—8th Street, Brooklyn 15, New York.

JUST SECURED: Most Modern Packaging and processing machinery. Equipment installed within last 2 years. Available at great savings. 4—Hayssen model F compaks with net weight scales, bulk and dribble feeds, electric eyes. 4—Ceco model 40-9½-GG automatic adjustable cartoning units. Also model TT. 1—Pneumatic Scale automatic carton feeder, Bottom Sealer and top sealer with interconnecting conveyors. 6—Fitzpatrick model D-6 Stainless Steel Comminuters. 4—Day size G. 1500 lb. Ribbon type powder mixers. 2—Rietz disintegrators model RD18 complete with 50 HP motors. 1—Enterprise Foundry Disintegrators Model EVM3 complete with 50 HP motors. Complete details and quotations promptly submitted. Union Standard Equipment Company, 318-322 Lafayette St., New York 12, N. Y., Phone: Canal 6-5334.

(Continued on page 270)

IMS PURE

SILICONE FLUID

MOLD RELEASE SPRAY

EXCLUSIVE, FAST,
ALL-METAL VALVE
ENDS FUMBLING
SAVES CYCLE TIME

Keeps Mold Lube Cost Down

It Isn't Size — It's Performance and Quality That Count!

PRICES (Delivered)

Sample Can	$2.00
Per Unbroken Dozen	$18.00
Per Unbroken Gross	$197.40

The Economical Way to Buy and Apply Pure, Costly Silicone Fluid!

To Cover All Molding Conditions Keep Both Types on Hand

IMS PURE

ZINC STEARATE

DRY POWDER SPRAY

HANDY MOLD DUSTER

Quick—Convenient

Removable, Cleanable Spray Head Directs Dust Into Cavity Without Waste.

PRICES (FOB Cleveland)

Sample Can	$2.00
Per Unbroken Dozen	$13.80
Per Unbroken Gross	$144.00

IMS Mold Releases are designed to bring you maximum quality and performance. Our Silicone Fluid Spray utilizes only more costly volatile Freon to minimize part marking on fast cycles. The Dry Powder Spray should be used in all applications where painting or plating follows the molding operation, also in preforming.

INJECTION MOLDERS SUPPLY CO.

3514 LEE ROAD • WYoming 1-1424 • CLEVELAND 20, OHIO

OPPORTUNITIES IN P.V.C.

Diamond Chemicals

Diamond Alkali Company is a leading producer of industrial chemicals with plants and sales offices located throughout the United States. The Plastics Division of Diamond is expanding, and offers challenging opportunities for personal growth and achievement.

SALES

OPPORTUNITIES FOR MEN WITH THE FOLLOWING QUALIFICATIONS:

Experience in technical sales and servicing Polyvinyl Chloride. Must be familiar with processing and compounding P.V.C. resins involving extrusion and calendering.

TECHNICAL SERVICE

NEW TECHNICAL SERVICE DEPARTMENT HAS OPPORTUNITIES FOR MEN WITH FOLLOWING QUALIFICATIONS:

B.S. or M.S. chemists or chemical engineers with experience in compounding or processing in the extrusion and electrical applications field.

RESEARCH

EXPANDING RESEARCH AND DEVELOPMENT DEPARTMENT HAS OPPORTUNITIES FOR MEN WITH FOLLOWING BACKGROUNDS:

Research: Chemist with Ph.D., M.S., or B.S., and 0 to 10 years' experience in polymers.

Pilot Plant: Engineers with B.S. or M.S. and 0 to 10 years' experience.

Applications: Chemist or Engineer, B.S. or M.S., with 0 to 10 years' experience in polymers.

Write to: WILLIAM L. ABELE, *Recruiting Dept.*
Diamond Alkali Company
300 Union Commerce Bldg., Cleveland 14, Ohio

THIS COMPANY made an ACCURATE MOLD in 1 HOUR and 50 MINUTES with

DEVCON C

At Northern Industrial Chemical Company, Devcon C was used to make a mold for phenolic parts in 1 hour and 50 minutes. The parts were molded at 350°F., 10,000 p.s.i. — complete experimental run was made without any change in the mold.

Devcon C is a combination of heat resistant plastic and metals. It is especially designed for making low cost compression and injection molds and other applications where high strength at elevated temperatures is essential. Devcon C is simply poured and formed around model. Makes a precision reproduction of every detail. No machining is required. Has high strength at 400°F. or higher — good heat transfer — and is extremely tough. Hardens permanently within two hours. Can be machined with regular metalworking tools. Available in 1 lb., 4 lb. and 15 lb. units.

Send for bulletin C today. Find out how you can get high quality molds at lower cost.

DEVCON CORPORATION

240 ENDICOTT STREET, DANVERS, MASS.

(Continued from page 268)

FOR SALE: 10 oz. DeMattia vertical injection molding machine. Ideal for insert work. Good condition. Approximately 2000 hours total machine time. $4750.00. Reply Box 3530, Modern Plastics.

FOR SALE: 150 Ton Stokes Automatic Closure Press. In perfect condition. Reply Box 3535, Modern Plastics.

Machinery wanted

POLYETHYLENE-EXTRUDER-LAMINATOR: Will purchase for cash top quality polyethylene extruder-laminator. Must be in excellent operating condition, 54" to 74" width, with all necessary parts and supplies. Send full details including price, hourly capacity, and pictures, if available, to Box 3525, Modern Plastics.

Materials for sale

FOR SALE: Styrene, hi-impact, large quantities reground available. White, light green, light blue, pink, etc. Low prices. Write, wire or phone, Success Plastics Corporation, P. O. Box 506, Indianapolis, Ind. LIberty 6-2919.

FOR SALE: Virgin high impact and medium-impact polystyrene. Natural, white, pastels, toy colors, and dark colors; also, virgin Polyethylene, natural and all colors. Prices—5¢ to 10¢ below regular list. Samples on request. Reply Box 3512, Modern Plastics.

FOR SALE: 50M lbs. exceptionally clean reground colored Butyrate, M-H flow, extrusion grade. 100M lbs., M.I. 2, Polyethylene scrap. Both attractively priced. Reply Box 3531, Modern Plastics.

Materials wanted

WANTED:
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid. Reply Box 3500, Modern Plastics.

POLYETHYLENE SCRAP WANTED: Also—Any other type. It will pay you to check our prices. Claude P. Bamberger, Inc. One Mount Vernon Street, Ridgefield Park, N. J. Telephone: HUbbard 9-5330.

NYLON SCRAP WANTED: by reprocessor. All kinds including molding, extrusion and fabricating. Quotations promptly furnished on all grades and polymer types. Adell Plastics, Inc., 5208 Elinor Avenue, Baltimore 15, Md.

PLASTIC SCRAP: Get top money—Now paying top prices for all thermoplastic scrap. Wanted: polystrene, cellulose acetate, vinyl, polyethylene, butyrate, acrylic, nylon. All types and forms including rejects and obsolete molding powders. Fast action wherever you are located. Write, wire today. Gering Products, Inc., Kenilworth, N.J.—New Jersey: Bridge 6-2900—New York: Cortland 7-3583.

WILL PURCHASE: For cash, prime or off grade Styrene, Polyester Resin (any type), Cellophane or Acetate Film (min. 36" wide), glass cloth, Mat or Rovings, Pigments and catalysts. Reply Box 3501. Modern Plastics.

PLASTIC SCRAP WANTED: From molders, vacuum formers, fabricators; acrylic, styrene, polyethylene, acetate, butyrate, etc. For top prices write, wire, phone collect Philip Shuman & Sons, 15-33 Goethe St., Buffalo 6, N.Y. Tel: HUmboldt 1811.

Molds for sale

FOR SALE: Compression molds for lighting bowls 8" diameter—9" diameter—12" diameter—15" diameter—15¾" diameter—16" diameter—16½" diameter—21" diameter. Reply Box 3528, Modern Plastics.

FOR SALE: Houseware molds, comb molds, also some novelty and specialty items. All in excellent condition. No reasonable offer refused. Send for list. Reply Box 3515, Modern Plastics.

Molds wanted

WANTED: Used doll's molds suitable for slush or rotational molding or casting. Super-Technique, 11 Rue De l'Avre, Paris 15.°

WANTED HOUSEWARE MOLDS: Want to purchase houseware molds for ice buckets, bowls, tumblers, refrigerator storage boxes, etc. Send literature. Reply Box 3505, Modern Plastics.

TURN IDLE MOLDS INTO BUSY CASH: Plastic molders and mold makers: do you have molds not in use that you would like to turn into cash? We are interested in molds for houseware items of all types, particularly tumbler molds. Send samples and all necessary information to: Ideal Products Corporation, 1117 Douglas Avenue, North Providence, Rhode Island.

WANTED: Toilet tank ball guides, plastic, for bottom of tank ball. If you have mold, write I. Richek, P.O. Box 10628, Charlotte 1, N. C.

Help wanted

SALES ENGINEERS: Leading manufacturer of standard mold sets, nationally advertised, requires services of full time representatives in several midwest areas. All around knowledge of moldmaking and molding essential. Wonderful opportunities for right men. Reply Box 3521, Modern Plastics.

WANTED — POLYETHYLENE - EXTRUSION - LAMINATION SUPERVISOR: Nationally known manufacturer packaging materials needs thoroughly experienced supervisor polyethylene extruson-laminating department. Career for man who can take complete charge production and supervise others. Main requirements: At least 5 years' supervisory experience with thorough knowledge machines and materials and proven ability to produce top quality product. This is opportunity to associate with leading organization in the packaging field. Growth and personal advancement based on performance. Liberal pension benefits. Our employees are aware of this advertisement. Write in strictest confidence all details background, education & experience. Reply to Box 3524, Modern Plastics.

PLANT MANAGER: Or technical position background or six years as plant manager of 10 machine custom molding plant doing top quality work. Excellent working experience in injection, sheet extrusion plus volume continuous vacuum forming techniques, mold design and tool room operations. Reply Box 3518, Modern Plastics.

PLASTICS ENGINEER: Age 25-35 for research development and quality control, by manufacturer of industrial and laboratory ware primarily from polyolefins. This is a ground floor position with a tremendous opportunity for a man with a good background in plastics forming. Salary open. Nalge Co., Box 365, Rochester 2, New York.

PVC COMPOUNDER: With strong experience in wire and cable work, for key technical sales position in young but vigorously growing division of substantial company. Graduate Chemist or Engineer with at least 5 years industrial experience preferred. Address replies in confidence to: H. E. Cooper, Polyvinyl Chloride Department, The Borden Chemical Company, 60 Elm Hill Ave., Leominster, Mass.

MANUFACTURER'S SALES REPRESENTATIVE WANTED: Midwest company manufacturing plastic injection molding machines seeking representatives in New England, South Atlantic and West Coast areas. Generous commission. Write details of your organization. Reply Box 3510, Modern Plastics.

WANTED—CHEMICAL ENGINEER: For development and processing of plastic slush moulded products. Position in large plant, located in Middle-Atlantic Seaboard town. Excellent opportunity to build a permanent career. Reply will be held in absolute confidence. Reply Box 3507, Modern Plastics.

SALES REPRESENTATIVE: Live wire for small thermoplastic Custom Injection Molding firm—Midwest & North Central coverage—Full time—salary & commission. Also part time on strict commission basis will be considered. Experience desirable but not necessary—Write stating qualifications, etc. Reply Box 3503, Modern Plastics.

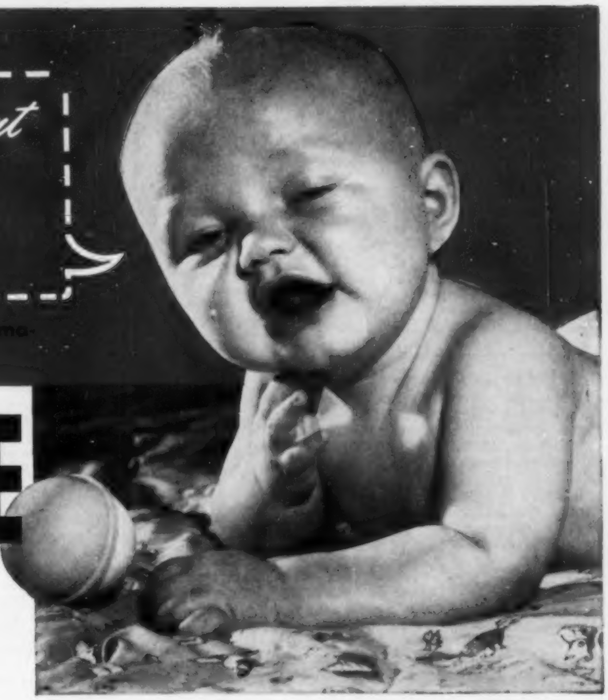
PLASTICS TECHNICAL SERVICE: Two plastics engineers with minimum of three years of experience in extrusion, calendering or molding and/or formulating vinyls are required immediately for Technical Service Laboratory. Must have B.S. in Chem. or Chem. Eng. Chemicals raw material manufacturer with modest thermoplastic activity starting large-scale expansion in this field. Unique opportunity for qualified men. Company is a subsidiary of major U.S. corporation thus assuring security, good working conditions, liberal benefit plans. Midwest location. Write giving complete details of experience, etc. Reply Box 3508, Modern Plastics.

PERSONNEL: Executive — Technical —Sales—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 220 South State, Chicago 4, Ill.—WAbash 2-4800. Call, write or wire—in confidence.

(Continued on page 272)

BRUTH-ERR...If you want a spanking good Color, take a tip from me!

— But, of course, we mean color that has permanence and brightness for product appeal . . .



STAN-TONE COLORS

For Every Rubber and Plastic Requirement . . .

***STAN-TONE MBS** — Masterbatch
Color dispersed and standardized in intensity for precision matching. It assures exact duplication of color in compounds and cleaner compounding.

***STAN-TONE PEC** — Polyester paste colors. Pigments selected for maximum heat and light stability. Custom matched to color requirements, in polyester resin.

***STAN-TONE Paste** — Color dispersed in plasticizer for use with vinyl resins.

***STAN-TONE GPE** —Color dispersed in polyethylene.

***STAN-TONE Dry Colors** —
All colors in powder form for all purposes.

*STAN-TONE registered U. S. Pat. Office.

Plasticizers and Softeners For All Resins and Rubbers . . .

*POLYCIZER DBS—(Dibutyl Sebacate)
*POLYCIZER DBP—(Dibutyl Phthalate)
*POLYCIZER 162—(Dioctyl Phthalate)
*POLYCIZER 332—(Dioctyl Adipate)
*POLYCIZER 532—(Octyl Decyl Adipate)
*POLYCIZER 562—(Octyl Decyl Phthalate)
*POLYCIZER 632—(Didecyl Adipate)
*POLYCIZER 662—(Didecyl Phthalate)
*POLYCIZER 662-BPA—(Electrical grade of 662)
*POLYCIZER BO—(Butyl Oleate)
*CELLUFLEX 179C—(Tricresyl Phosphate)
*CELLUFLEX 112—(Diphenyl Cresyl Phosphate)

PLASTICIZER ODN . . . Very effective softener for acrylonitrile rubbers.
PLASTICIZER SC . . . Good low-temperature plasticizer.

*Registered U. S. Patent Office.

1932 1957 25 YEARS OF SERVICE HARWICK STANDARD CHEMICAL CO. AKRON, OHIO, U.S.A.

Write for complete data

HARWICK STANDARD CHEMICAL CO.

60 SOUTH SEIBERLING STREET, AKRON 5, OHIO

BOSTON 16, MASS. 661 BOYLSTON STREET · TRENTON 9, NEW JERSEY 2595 E. STATE STREET · CHICAGO 25, ILLINOIS 2724 W. LAWRENCE AVE. · LOS ANGELES 21, CALIF. 1248 WHOLESALE STREET · ALBERTVILLE, ALA. OLD GUNTERSVILLE HWY.

(Continued from page 270)

DEVELOPMENT CHEMIST: Experienced in thermosetting resins for grinding wheel and related fields. Excellent opportunity. Location Northern, New Jersey. National known firm. Salary commensurate with background. All replies confidential. Reply Box 3502, Modern Plastics.

DEPT. HEAD: Rubber company wants man to head up and operate a department with 50,000 lbs daily capacity for re-processing vinyl and polystyrene. Excellent money making potential for the man with "Know How" in this field. Keaton Rubber Company, Kearney, New Jersey.

REINFORCED PLASTICS MANAGER: Broad experience in new fiberglass product development and production. Have successfully set-up and administered complete divisions. Emphasis on large structures, building panels and missiles. An extremely cost conscious and highly respected manager who can assume full responsibility. Seeking company with promising growth potential. B.Ch.E. Age-37. $14,000 caliber. Reply Box 3509, Modern Plastics.

INJECTION MOLDING SUPERINTENDENT: Needed by expanding company in Midwest area. Must be familiar with all thermoplastic materials. Also require Decorating Superintendent familiar with painting and plating operations. Salaries commensurate with experience. Reply Box 3504, Modern Plastics.

COMPOUNDING MAN: Expd vinyl. polyvinyl chloride resin mfr has an opening for expd. vinyl compounding man. Position is a most attractive one where you can grow with one of the fastest growing companies in the industry. Our company has been in business for many years. This will be a new dept that you can set up to your own thinking and manage it. New England area. Reply Box 3533, Modern Plastics.

PVC SALESMAN: Polyvinyl chloride resin & compound manufacturer seeks aggressive, experienced salesman. Liberal compensation, excellent potential, exclusive territories available throughout the United States. Interview directly with top management. Send resume & full details in confidence. Reply Box 3532, Modern Plastics.

EXTRUDER ENGINEER-PRODUCTION MANAGER: Unusual opening! New England mfr with 14 extruders and others coming in. Also have some equipment set-up for blowing. Seeking man experienced in the extrusion of polyethylene, vinyl & polyethylene sheets & tubes. This is one of our fastest growing depts. Will make most attractive proposition to qualified man. Reply Box 3534, Modern Plastics.

CHIEF ENGINEER FOR EUROPE: To supervise entire program of complex mold-making there. Read the full-page REVELL ad on page 82.

WANTED: Large Miami, Fla. manufacturer has need of an expert rigid vinyl man to operate an N.R.M. vinyl machine. Only a person with previous experience in rigid vinyl need apply. Write Air Control Products, Inc., 3601 N. W. 54th Street, Miami, Florida.

CHEMICAL PROJECT ENGINEER: Excellent oportunity for a Chemical Engineer or equivalent to serve as a Chemical Project Engineer with the nations leader in the whiteprint industry located in Southern New York. Experience desired in paper, coated material or film. Send detailed resumes in confidence with salary requirements to: Employment Department, Ozalid, Johnson City, New York.

Situations wanted

MANAGER: INDUSTRIAL PLASTICS OR ALLIED INDUSTRY. Twenty consecutive years invaluable engineering and managerial experience in injection, compression, laminating and finishing. Broad knowledge of business administration, Production management and Industrial engineering. Ability to plan, organize, motivate and direct action and maintain harmonious and practical labor relations. Reply Box 3529, Modern Plastics.

MANUFACTURERS REPRESENTATIVE: If you are looking for an agent with thorough knowledge of plastics, let's get together. Company must be financally sound and be able to think modern. Prefer to sell to industrial accounts, including automotive. Territory: Michigan. Reply Box 3527, Modern Plastics.

PLASTICS MANUFACTURER'S REPRESENTATIVE: For East coast. Offers six years experience thermoplastic raw materials sales background for starting new agency. Interested in proprietary finished goods or specialty plastic raw materials. Offer integrity and enthusiasm in this venture. Begin July 1958. Reply Box 3517, Modern Plastics.

PIPE & TUBING EXTRUSION: Young executive with Mechanical Engineering background and pipe extrusion experience including linear polyethylene desires responsible position with a progressive and stable organization. Capable of handling personnel and production. Will travel if necessary. Reply Box 3514, Modern Plastics.

EXTRUSION SPECIALIST: With 14 years experience in rods, tubes, profiles, sheeting, film and extrusion coating. Heavy experience in flat film and blown tubing. Working knowledge of all thermoplastics. Background experience includes process development and engineering, production supervision and new plant installations. Seek management position in production capacity. Reply Box 3513, Modern Plastics.

MANUFACTURERS' AGENT covering all of New York state excluding New York City is seeking a custom molded plastics line. Well established and has excellent contacts among industrial purchasing agents. Calling on electronics, automotive and diversified industries with allied lines. Full particulars upon request. Reply Box 3506, Modern Plastics.

Miscellaneous

FOR SALE: Modern optical plastic frame plant, fully equipped, 2 years old, with or without building. For details, Reply Box 3516, Modern Plastics.

PATENT AVAILABLE: For licensing on royalty basis. Bottle identifying device. Patent number 2,810,490. Identify's advertises contents of bottles. A safety guard and stops evaporation. Manufactured from plastic and pliable rubber. Market outlets, drug stores, chemical mfgs, and the general public. Patent copy on request. Walter Cook, 3526 W. Highland Blvd., Milwaukee 8, Wis.

PLASTIC WALL TILE BUSINESS: Wanted to buy—Multi-plant manufacturer of plastic products seeks to expand via related product line. Would like to purchase going plastic wall tile firm. Must market F.H.A. approved tile along with any other lines. Location East of the Rockies. Annual volume over $500,-000.00 Prefer company with established brands. If interested, please reply giving sales for last three years, product literature, latest balance sheet available, a list of injection equipment by make, model and year and, if possible, some indication of selling price desired. Reply will be held in strictest confidence. Reply Box 3522, Modern Plastics.

BRITISH SPECIALIST: Offers new processes & patents on plastics by license or other agreement including (1) production of glass fibres 20% cheaper than present methods (2) mechanicals in production of custom-built tanks, ducts, etc. of glass fibre laminates with greatly increased life and reducted cost (3) glass fibre reinforced pipes with prestressed fibres, hence long life yet lower cost. Ingochem S.A., Elizabethenstrasse 15, Basle 1, Switzerland.

WANTED — POLYETHYLENE EXTRUSION BUSINESS: AAA-1 nationally known manufacturer packaging products wants to purchase established polyethylene extrusion-laminating business. Interested in first-class equipment and have openings for qualified production personnel at all levels. Can absorb total assets or polyethylene equipment and personnel only, as preferred. Variety of payment possibilities available to seller's advantage. Submit full details, with detailed specifications of equipment and personal history resumes of personnel available in strictest confidence. Personal discussions arranged with principals on short notice. Reply Box 3526, Modern Plastics.

CAPITAL TO INVEST: Commercial and real estate financing. 1st & 2nd Mortgages. Construction loans. Chattel loans on machinery, equipment, fixtures & inventory. Sales & leaseback. Present financing consolidated and increased. Payments reduced. Receivable discounting. Re-discounting and installment financing. Long term subordinated note and debenture financing. New ventures financed. Promotional financing. Sy Field Co., 1457 Broadway, N. Y. WI 7-7395.

PLASTICS EXTRUSION: West Coast. 65 active accts. Dies eng. to customer spec. on contr. basis. Advanced tech. Loc. indus. dist. lg cty. Bldg & RE opt. Eqpt. val. $65,000. Gross mo. $35,000. Net 20%. Plastics for indus. field wide open. $80,-000 dwn. Write B24630 Business Mart Of America, 5723 Melrose Avenue, L.A. 38, California.

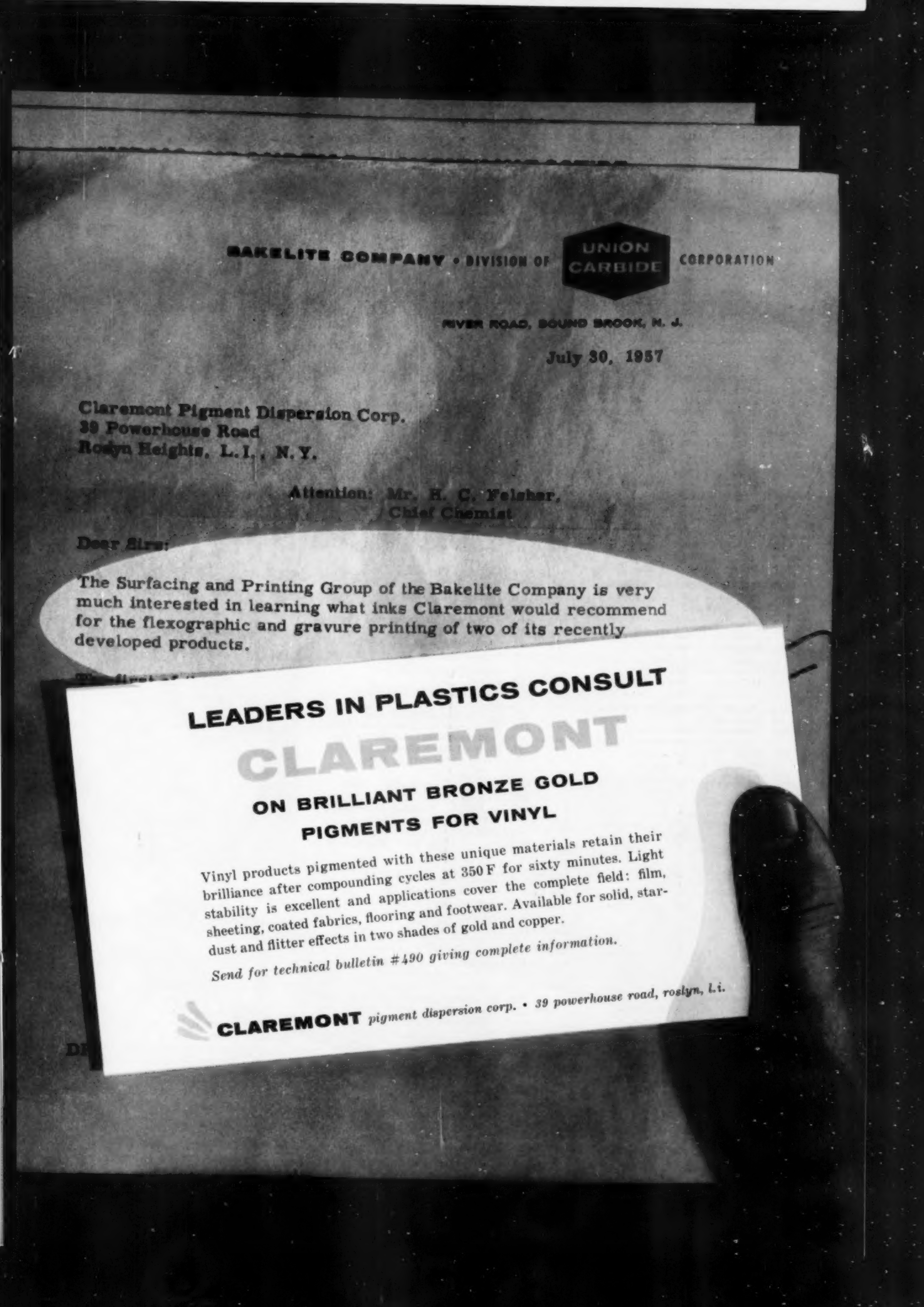
All classified advertisements payable in advance of publication.

Closing date: 24th of second preceding month, e.g., May 24 for July issue

Per inch (or fraction)....................$20.00; each 3 inches or fraction (in border) $10.00 extra
For purposes of establishing rate, figure approximately 50-55 words per inch.

For further information address Classified Advertising Department, Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y.

Modern Plastics reserves the right to accept, reject or censor classified copy.


BAKELITE COMPANY • DIVISION OF UNION CARBIDE CORPORATION
RIVER ROAD, BOUND BROOK, N. J.
July 30, 1957
Claremont Pigment Dispersion Corp.
39 Powerhouse Road
Roslyn Heights, L. I., N. Y.
Attention: Mr. H. C. Felsher, Chief Chemist
Dear Sirs:
The Surfacing and Printing Group of the Bakelite Company is very much interested in learning what inks Claremont would recommend for the flexographic and gravure printing of two of its recently developed products.
LEADERS IN PLASTICS CONSULT
CLAREMONT
ON BRILLIANT BRONZE GOLD
PIGMENTS FOR VINYL
Vinyl products pigmented with these unique materials retain their brilliance after compounding cycles at 350 F for sixty minutes. Light stability is excellent and applications cover the complete field: film, sheeting, coated fabrics, flooring and footwear. Available for solid, star-dust and flitter effects in two shades of gold and copper.
Send for technical bulletin #490 giving complete information.
CLAREMONT pigment dispersion corp. • 39 powerhouse road, roslyn, l.i.

Index of Advertisers

May 1958

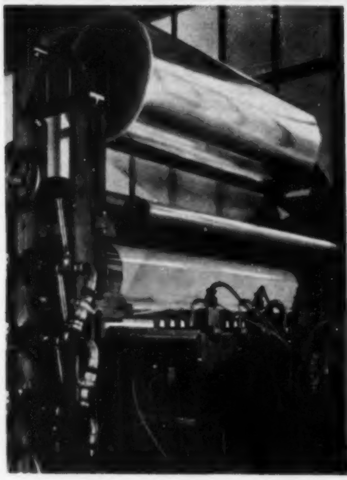
Distribution of this issue: 33,200

(*Continued on page 276*)

For plastic-sheets

.... extrude it on a Reifenhäuser!

(with screw diameters $1\frac{1}{4}''$, $1\frac{3}{4}''$, $2\frac{1}{2}''$, $3\frac{1}{2}''$, and $6''$ approx.)

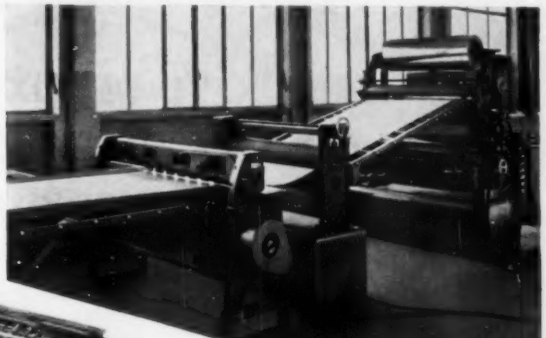


Special slit-die head and polishing machine

In addition to our line of extruders ($1\frac{1}{4}''$, $1\frac{3}{4}''$, $2\frac{1}{2}''$, $3\frac{1}{2}''$ and $6''$ screw dia.) Reifenhäuser furnishes complete and automatic "package units", for every type of Thermoplastic Extrusion.

Yes, Reifenhäuser Extrusion Equipment enjoys a world-wide reputation for its superior engineering features, its dependability to extrude difficult materials, and its efficiency in operation.

Keep in step with progress by writing us today for full information on the new Reifenhäuser Extruder.



The plant for plastic-sheets – General view –

Automatic sheet stacking table

Representative for sales and service in USA:
H. H. HEINRICH, INC.
111 Eighth Avenue, NEW YORK 11, N.Y.

Reifenhäuser KG

MASCHINENFABRIK

Troisdorf, West. Germany

(Continued from page 274)

MODERN PLASTICS

A BRESKIN Publication

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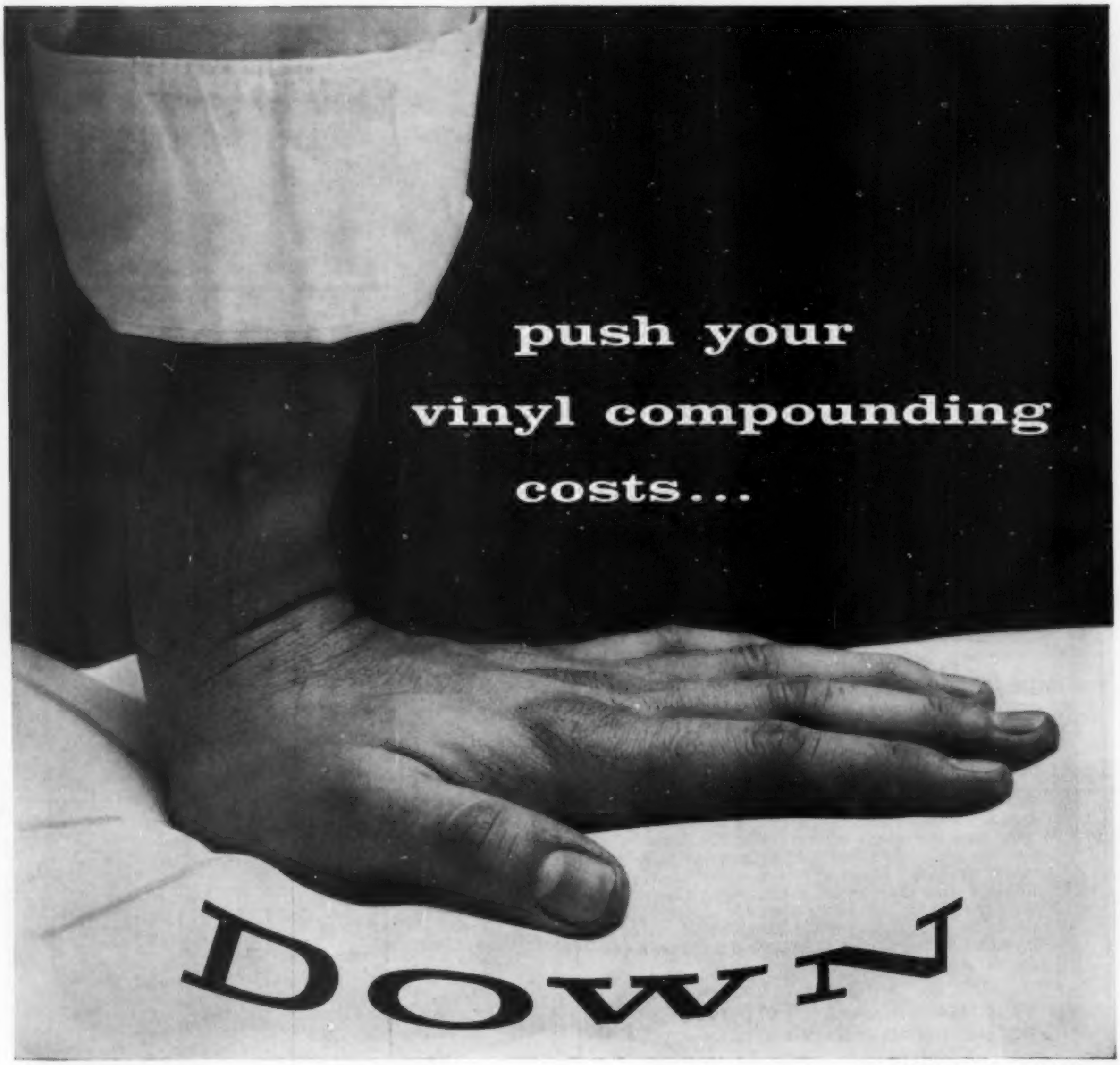

with Chlorowax 40®

Using Chlorowax 40 has enabled many processors to cut their compounding costs up to 2½c per pound volume—without sacrificing other important properties!

This versatile secondary plasticizer helps maintain desirable properties which are inherent in vinyl resin.

Nonflammability
Resistance to acid, alkalies and water
Nontoxicity

Reports from many users of Chlorowax 40 in pigmented extrusion compounds indicate that improved processing characteristics are possible.

Choose Chlorowax 40 for prolonged flexibility where other highly volatile secondaries have left your product stiff and brittle after aging.

Write today for our technical bulletin, *Chlorowax 40—a Secondary Plasticizer for Polyvinyl Chlorides.* It contains some suggestions which will help you adapt Chlorowax 40 to your compound. DIAMOND ALKALI COMPANY, 300 Union Commerce Bldg., Cleveland 14, Ohio.

Diamond Chemicals


SHIRT SLEEVE
HELP FOR
RESIN
MAKERS

WHY A LEADING MOLDER FINDS EXTRA VALUE IN G-E PHENOLICS

All these parts were made from G-E phenolics by Watertown Mfg. Co., Watertown, Conn., one of the industry's most versatile molders.

For applications like those shown here, no engineering material works as well as phenolics. But the **extra** value in phenolics today—to molder and user alike—stems from the variety of compositions that permit custom-tailoring of desired end properties.

G.E.'s broad line of phenolics and able technical service offer molders this variety with all the advantages of dealing with a single source. Says Mr. G. G. Welch, vice president of Watertown, "G.E. has a compound for just about every requirement we're called upon to meet. That gives us freedom of choice in design and an opportunity to use the most economical technique for the job to be done. At the same time it simplifies materials inventory and reduces scrap losses."

This is extra value right down the line. It will pay you, too, to investigate the extra values in G-E phenolics. Call or write General Electric Company, Chemical Materials Dep't., Section MP 58, Pittsfield, Mass.

Phenolics-first of the modern plastics...first in value

GENERAL ELECTRIC